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Circular No. 859

Evaluating School Lunches and Nutritional Status of Children

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UNITED STATES DEPARTMENT OF AGRICULTURE
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The work involved in this project represents the combined efforts of many individuals and resources of two schools, county health authorities, and two governmental agencies. The following list brings out very clearly that any large-scale nutritional study requires the coordinated activity of a number of specialists. Each area of contribution by the collaborating agencies is listed with persons directly responsible for each part of the study.

United States Public Health Service was responsible for obtaining and analyzing data and preparing the report on the following:

Physical examination of the children:
Richmond K. Anderson, physician
Clarence Velat, physician
Dolores Howley, nurse
Margaret McLaughlin, nurse consultant
Rose Fortuna Manson, nurse

Dietary interviews with children, see page 6, footnote 1.

Biochemical analyses for hemoglobin and serum carotene:
Nicholas Barbella, chemist
Dorothy Kremen, technician
Benjamin Mehlman, technician

Tabulations, analyses, and preparation of report:
Olaf Mickelsen, biochemist
Elliott Pennell, statistician
Georgia Druzina, statistician

Advisory:
Harold R. Sandstead, physician, chief, Nutrition Branch
Fred W. Morse, physician, Nutrition Branch

Bureau of Human Nutrition and Home Economics was responsible for obtaining and analyzing data and preparing the report on the following:

Biochemical analyses for serum ascorbic acid and chemical analyses of school meals as served:
Milicent L. Hathaway, nutrition specialist
Frieda L. Meyer, nutrition specialist
Myrtle Brown, nutrition specialist
Alvin Caldwell, chemist
Guy Gibson, chemist
Samuel Ringel, chemist

Home food consumption of children and families, as reported by the mother:
Sadye F. Adelson, food economist
Betty B. Peterkin, home economist

Tabulations, analyses, and preparation of report:
Milicent L. Hathaway, nutrition specialist
Frieda L. Meyer, nutrition specialist
Sadye F. Adelson, food economist
Betty B. Peterkin, home economist
Elsie Dochterman, statistician

Advisory:
Esther L. Batchelder, head, Food and Nutrition Division
Esther F. Phipard, assistant head, Family Economics Division

State and local authorities assisted in planning and facilitated contacts:

Maryland State Department of Health:
Ann Matthews, chief nutritionist
Mayton Zickefooze, assistant nutritionist
M. Arnold Gunther, director, local laboratory

Principals of the schools studied:
Agnes Carroll
Jane Higgins
Bernice Winner

Home dietary interviewers, see page 82, footnote 4.

Allegany County:
Joseph P. Franklin,* County Health Officer, 1946–47
Winter R. Frantz, County Health Officer, 1947–48
Charles L. Kopp, County School Superintendent
William P. Cooper, director, school lunch program
Gladys M. Eaton, supervisor, school lunch program

*Deceased

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UNITED STATES DEPARTMENT OF AGRICULTURE

Evaluating School Lunches and Nutritional Status of Children

By Clarence Velat and Olaf Mickelsen, *United States Public Health Service*, and Milicent L. Hathaway, Sadye F. Adelson, Frieda L. Meyer, and Betty B. Peterkin, *Bureau of Human Nutrition and Home Economics, Agricultural Research Administration*

SUMMARY

The nutritional status and diet of children with and without a school lunch were studied in two selected elementary schools in Cumberland, Md., in the spring of 1947 and 1948. This was a pilot study designed to correlate and evaluate clinical, biochemical, and dietary methods.

In the "Control School," a plate lunch was not available the first year but one was served the second year, whereas the "Lunch School" had served a noon meal for a number of years. On the basis of their participation in the school-lunch program, the children in each school were divided into three groups: Those who regularly ate the school lunch, those who did not participate, and an intermediate group. The comparative analysis in this report is confined to the first two.

Physical examinations for signs suggestive of nutritional deficiency revealed that all of the children in the study were in fairly good physical condition. For the most part only mild, if any, physical signs possibly suggestive of malnutrition were seen.

The clinical findings showed no consistent differences between children receiving a lunch at school and those not participating in the school lunch. The findings indicate a need for studying children who are initially in different nutritional states, especially the undernourished. Comparisons made between separate small samples of boys and girls 8, 9, and 10 years old in the same school-lunch group in both 1947 and 1948 showed that the samples should be carefully matched for various physiological and socioeconomic factors.

The biochemical analyses of the blood for hemoglobin showed the same general picture for all groups in both schools regardless of the children's participation in the lunch program. In 1947 and 1948 serum carotene and serum ascorbic acid were both higher in children receiving a school lunch than in those without a school lunch. The values were higher in both groups in 1948 than in 1947. A citrus fruit concentrate served frequently as a part of the school lunch may have been responsible in part for the higher serum ascorbic acid levels

in the school-lunch group. For the groups with and without a school lunch there was no consistent correlation between biochemical and clinical findings.

A home dietary study, made of a portion of the families having children in the third to sixth grades of both schools, showed the diets of the families of these children in both schools to be similar except for higher ascorbic acid values in those of the Lunch School families. In the first year the percentage of children's diets meeting the recommended allowances of the National Research Council for vitamin A, ascorbic acid, and calcium was higher in the group having a school lunch than in the group with no school lunch. The diets of the two groups were comparable for the other nutrients studied. With the introduction of the lunch program in the Control School the second year, the diets of the children participating in the school lunch approached those of the comparable group in the Lunch School. Comparison of school and home meals indicated that the school lunches supplemented the home diets of the children.

Chemical analyses of 29 school lunches as served to the older children (10 to 12 years), showed that the majority of the meals met 25 to 35 percent of the daily food energy values recommended by the National Research Council for children of this age group, 30 to 45 percent of the protein, 30 to 50 percent of the calcium, 20 to 30 percent of the thiamine, 40 to 65 percent of the riboflavin, and 1 of 100 or more percent of the ascorbic acid allowances. In the case of thiamine, 15 meals supplied 25 percent or less, and only 3 furnished 33 percent or more. Ascorbic acid values were variable, the quantity depending largely on the citrus fruit content of the meals. No meal without citrus products supplied as much as 30 percent of the recommended daily allowances for this vitamin.

On the basis of this work, suggestions are made that may aid in future studies designed to determine the nutritional effect of the school lunch.

PURPOSE AND PLAN OF THE STUDY

Congress in 1946 recognized the nutritional significance of the school lunch when it declared that the National School Lunch Act was "a measure of national security, to safeguard the health and well-being of the Nation's children." The act also states that "Lunches served by schools participating in the school-lunch program under this Act shall meet minimum nutritional requirements prescribed by the Secretary (of Agriculture) on the basis of tested nutritional research."

Various governmental agencies have been interested in different aspects of the school-lunch program. In 1941 these group voluntarily organized as the Cooperating Committee on School Lunches. The Committee reorganized in January 1947 at which time it changed its name to Interdepartmental Committee on School Lunches. One of the problems considered by this group was the methods whereby the effectiveness of the school-lunch program could be evaluated from an educational, economic, and nutritional standpoint.

In 1945 the Committee suggested bringing together individuals active in each of these fields for a conference on school lunch study

to recommend ways of achieving these goals. The group of conferees considering the nutritional aspects of this problem recognized that evaluation of the influence of the school lunch upon the well-being of children called for data that could come only from carefully controlled studies. The group outlined specifications for an experimental project that would permit an evaluation of the effect of the school-lunch program upon the health, physical status, food habits, and school progress of the children. (See appendix A for the recommendations.)

A project utilizing all of the criteria specified by this conference group would have been a very expensive undertaking. Since funds were not immediately available for such an extensive study, it was deemed advisable to use existing facilities in different agencies for making a pilot study covering selected criteria. It was believed that a preliminary study would indicate the problems involved in such work and might show up the areas of the plan needing more concerted attention.

This is a report of the pilot study prepared not as a final answer to the question of the influence of the school lunch on the nutritional health of the children, but rather as a basis upon which subsequent studies can be designed.

General Plan

The study was possible because of a special set of circumstances. In the spring of 1946, the United States Public Health Service, upon invitation from the State and county health officers, had assigned a nutrition unit to Allegany County, Md. The county health department had put at their disposal laboratory and office space and nursing services. It was found that in Cumberland, the county seat, there was one elementary school which, through lack of facilities, did not have a school-lunch program in 1946–47. Even then milk and ice cream were available at cost to the children, both at noon and at recess. All of the other elementary schools served a plate lunch at noon. Local officers and representatives of the Federal agencies on the Interdepartmental Committee on School Lunches agreed that the setting offered a good opportunity for a pilot study of the influence of the school lunch on the nutritional health and dietary habits of the children.

It was decided that the school which was not participating in the school lunch program in 1946–47 would serve as the control (Control School). The findings in the Control School were to be compared with those for another elementary school serving a plate lunch (Lunch School). This school was selected with the assistance of the school authorities to be as similar as possible to the Control School in number of pupils and economic status of their families. In the fall of 1947 in response to local demand, a school lunch program was started in the Control School. Because this school had no facilities for the preparation of hot foods, these items were brought in thermos containers from a nearby school.

During the summer of 1946 plans were drawn for the project which was to start in the fall term. It was decided to follow the changes in heights, weights, selected physical signs suggestive of nutritional deficiencies, the level of certain blood constituents of the children,

and the dietary patterns of the children in the two schools and of their families. These tests and measurements, first made in the fall of 1946, were repeated in both schools in the spring of 1947 and again in the spring of 1948 after the school lunch program had been operating in the Control School for 6 months. Since the results of certain tests used in this study show seasonal variations, this report presents only the findings for the spring of 1947 and 1948.

Description of the Sample

Cumberland, Md., is a city of about 40,000 people (1940 census). The city is a shipping center for bituminous coal from nearby mines; the chief industries are railroad repair shops, a celanese plant, a tire and tube-manufacturing company, two breweries, and a paper mill.

There were 2 high schools and 12 elementary schools in Cumberland. Each of the 2 elementary schools chosen for this study had a total enrollment of about 475 children. The Lunch School, located near the east edge of town, had some children coming in from a rural area. The Control School, about 2 miles away, also situated near the edge of town, had some children coming in from a suburban area.

A survey of a sample of the families of the children in the two schools showed the number of persons in the household and the educational background of the homemaker to be similar (table 1). However, families whose children attended the Control School had slightly higher average incomes than those whose children attended the Lunch School. Among the latter there were more very low-income families and the top incomes were lower.

There is indication also that the families whose children were in the Lunch School raised more food for their own use and spent less for purchased food than did families with children in the Control School. The survey of home food supplies revealed that the Lunch School families used about 25 percent more potatoes and green and yellow vegetables, and about 10 percent more milk, eggs, meat, and other vegetables and fruits than did the Control School families.

The school authorities attempted to circumvent economic factors as an influence in the child's participation in the school lunch program. On recommendation of teachers and principals, free lunches were made available to the needier children.

During the 2 years of the study, approximately 10 percent of the children received free meals.

In the first year (spring 1947) the charge for the lunches was 90 cents a week or 20 cents a meal, whereas in the second year (spring 1948) it was $1 a week or 22 cents for a single meal. The teachers collected the money and kept a record of the child's participation in the lunch program. On the completion of the study, these records served as the basis for determining the groups into which the children were classified for this report.

In the fall of 1947 about 100 pupils were transferred from the Control School to another school but since the latter served a lunch comparable to that which had just been started in the Control School, all of these transferred children have been treated as though they remained in their original school. All other pupils who transferred from one school to another during the 2-year period have been excluded from this study.

An invitation was extended to all children to participate in the study (except the family dietary phase) whether or not they participated in the school lunch program. Physical examinations were made on about 98 percent of the children. However, the data compiled for this report include only those for children for whom height and weight records were available in both years.

Within each school the sample of children having the 2-year height-weight records were separated into three groups: Children with no school lunch—those who participated on an average not more than once a week; children with occasional school lunches—those who on an average participated more than once but not more than four times a week; and children with school lunches—those who participated on an average more than four times a week. These averages were based on the teachers' records for the periods of the study—6 weeks during March and April in 1947 and again in 1948. (The data for the intermediate group are included in most of the tables to complete the statistical story but are not discussed.)

The extent to which children participated in the school lunch as classified in this study differs from that reported by the school. The percent of the children who participated in the school lunch was:

	Lunch School		*Control School*
	1947	*1948*	*1948*
As reported by school	72	74	57
As classified for this study	52	60	60

The participation as reported by the school was based upon school records of the number of meals served during May in each year. The participation of the sample in the study was based upon the teachers' records for March and April. The differences may be due to the fact that, by definition, only those children who received an average of more than four lunches per week were classified in the school lunch group; any child who, over the 6-week period received fewer than 25 lunches was included in the group with occasional school lunch, and as such, was not counted for the above comparison. There may have been some differences in school lunch participation in March and April, as compared with May.

In the Lunch School some variation in the school lunch participation occurred from year to year. Of the 174 children who were in the school lunch group in 1947, 151 (87 percent) also participated in 1948 (table 2). Of the 78 children without a school lunch in 1947, 53 (68 percent) were in the same category the following year. Of the 84 children with occasional school lunch, only 21 remained in this category both years.

Boys and girls were not equally represented in all of the groups involved in the study, especially when classification was made according to age. In the Control School the group of children 6 to 9 years old was equally divided according to sex; the group of children aged 10 to 12 included almost one and a half times as many boys as girls. In the Lunch School there was a larger number of girls than boys in the group aged 6 to 9 years; the sexes were equally represented in the older groups. (See tables 3 and 4.)

The proportion of children of different ages with and without a school lunch varied widely in the 6- to 9- and 10- to 12-year-old groups in both schools in 1947 and 1948. Lack of comparability in the com-

position of the participating groups may have affected the findings, but the total sample was too small to permit analyses throughout by groups paired strictly for age, sex, and rate of school lunch participation.

The rate of school lunch participation followed no consistent pattern with respect to age and sex groups. Slightly more children under 10 years than of those 10 and over participated in the school lunch in the Lunch School both years. In the Control School, however, the participation in 1948, was slightly higher among the older children. In the Lunch School the ratio of boys to girls in the school lunch group was 0.7 to 1 both years, and in the group without a school lunch it was 0.8 to 1 and 1 to 1 for the two years, respectively. However, in the Control School the ratio of boys to girls in the lunch group was 1 to 1 and in the group without a school lunch it was 2 to 1.

A number of factors restricted the size of the subsamples available for the various tests and measurements (table 5). For one thing, parental consent was required before any blood samples were taken, thus eliminating a number of children from this phase of the study and possibly distorting the proportions with and without a school lunch.

The sample for one of the dietary studies was reduced by the fact that younger children are not considered competent to record their food intake. For this reason 1-day dietary records obtained by the U. S. Public Health Service were taken through interviews with children in the fourth to sixth grades only,[1] Eads and Meredith (*19*).[2] Seven-day records of food consumed by a still smaller sample of children were obtained by the Bureau of Human Nutrition and Home Economics through the cooperation of mothers willing to keep records of food consumed by the family as well as by the children in the third to sixth grades. (See appendix D.)

TABLE 1.—*Economic status of families of third- to sixth-grade children, Control and Lunch Schools, spring 1947*

Item	Control School	Lunch School
Families—number	53	44
Persons per household (average)—do	5. 0	5. 2
Monthly income per family (average)—dollars	262	224
Families having less than $50 income per person per month—percent	55	52
Food expenditures per person per week (average)—dollars	4. 30	4. 10
Families spending less than $4 per person per week for food—percent	42	46
Families with employed homemakers—do	13	2
Years of formal education reported by homemaker (average)—number	9. 2	9. 5

[1] These data will be published later when the nutrient content of the diets has been calculated. U. S. Public Health Service staff who worked on this part of the study were: Miriam Eads, Alla Meredith, and Marjorie Vaughn, nutritionists; French Boyd and Helen Walsh, nutrition consultants.

[2] Italic numbers in parentheses refer to Literature Cited, p. 73.

TABLE 2.—*Change in school lunch participation by children, Lunch School, spring 1947 and spring 1948*

Participation group	All ages				Ages 6 to 9 in 1947				Ages 10 to 12 in 1947			
	Total children, 1947	Same children in 1948			Total children, 1947	Same children in 1948			Total children, 1947	Same children in 1948		
		No school lunch	Occasional school lunch	School lunch		No school lunch	Occasional school lunch	School lunch		No school lunch	Occasional school lunch	School lunch
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total children	336	89	46	201	239	62	32	145	97	27	14	56
No school lunch	78	*53*	11	14	57	*38*	9	10	21	*15*	2	4
Occasional school lunch	84	27	[1] *21*	36	58	16	*11*	31	26	11	*10*	5
School lunch	174	9	14	*151*	124	8	12	*104*	50	1	2	*47*

[1] Numbers in italics refer to children in the same participation group in 1947 and 1948.

TABLE 3.—*Number of children by age, sex, and degree of school lunch participation, Control School, 1947 and 1948*

Age group [1]	1947 [2]			1948 [3]								
	No school lunch			No school lunch			Occasional school lunch			School lunch		
	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls
All ages	340	183	157	81	55	26	54	27	27	205	101	104
6 to 9 years	222	114	108	56	38	18	34	16	18	132	60	72
6 years	44	21	23	10	8	2	4	2	2	30	11	19
7 years	52	32	20	14	10	4	11	6	5	27	16	11
8 years	62	33	29	16	10	6	8	4	4	38	19	19
9 years	64	28	36	16	10	6	11	4	7	37	14	23
10 to 12 years	118	69	49	25	17	8	20	11	9	73	41	32
10 years	68	38	30	17	10	7	12	6	6	39	22	17
11 years	34	22	12	5	5	-------	8	5	3	21	12	9
12 years	16	9	7	3	2	1	-------	-------	-------	13	7	6

[1] Based on age reported at time of examination, spring 1947.
[2] No school lunch program in 1947.
[3] Total children same as in 1947.

TABLE 4.—*Number of children by age, sex, and degree of school lunch participation, Lunch School, 1947 and 1948*

Age group [1]	All groups			No school lunch			Occasional school lunch			School lunch		
	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls
	1947											
All ages	336	155	181	78	35	43	84	45	39	174	75	99
6 to 9 years	239	105	134	57	24	33	58	28	30	124	53	71
6 years	40	14	26	15	6	9	8	2	6	17	6	11
7 years	54	15	39	9	3	6	15	6	9	30	6	24
8 years	77	40	37	17	7	10	19	13	6	41	20	21
9 years	68	36	32	16	8	8	16	7	9	36	21	15
10 to 12 years	97	50	47	21	11	10	26	17	9	50	22	28
10 years	46	24	22	7	3	4	10	6	4	29	15	14
11 years	40	20	20	9	6	3	14	9	5	17	5	12
12 years	11	6	5	5	2	3	2	2	--	4	2	--
	1948											
All ages	336	155	181	89	44	45	46	26	20	201	85	116
6 to 9 years	239	105	134	62	29	33	32	15	17	145	61	84
6 years	40	14	26	13	3	10	3	1	2	24	10	14
7 years	54	15	39	15	9	6	6	--	6	33	6	27
8 years	77	40	37	18	12	6	13	8	5	46	20	26
9 years	68	36	32	16	5	11	10	6	4	42	25	17
10 to 12 years	97	50	47	27	15	12	14	11	3	56	24	32
10 years	46	24	22	9	5	4	6	4	2	31	15	16
11 years	40	20	20	15	8	7	7	7	--	18	5	13
12 years	11	6	5	3	2	1	1	--	1	7	4	3

[1] Based on age reported at time of examination, spring 1947.

TABLE 5.—*Number of children studied for various tests and measurements, Control and Lunch Schools, 1947 and 1948*

Item	1947				1948			
	Total children	No school lunch	Occasional school lunch	School lunch	Total children	No school lunch	Occasional school lunch	School lunch
	Control School							
Physical examinations	338	338	------	------	340	81	54	205
Blood studies:								
Hemoglobin	280	280	------	------	299	69	43	187
Carotene	244	244	------	------	197	43	28	126
Ascorbic acid	255	255	------	------	255	59	39	157
Absentee records	287	287	------	------	286	81	------	205
	Lunch School							
Physical examinations	330	77	83	170	336	89	46	201
Blood studies:								
Hemoglobin	310	71	73	166	321	83	44	194
Carotene	261	61	64	136	236	57	32	147
Ascorbic acid	301	70	72	159	301	77	42	182
Absentee records	290	89	------	201	290	89	------	201

PHYSICAL AND BIOCHEMICAL EXAMINATIONS

Physical Examinations

During the past two decades considerable attention has been devoted to the skin and mucosal changes associated with vitamin deficiencies. Definite symptoms are found in severe-deficiency states but milder forms of these conditions are not easily recognized. In the area of mild deficiencies there has been considerable discussion of the significance and interpretation of many epidermal symptoms that were originally associated with a specific deficiency. In view of this situation, the suggestions of the Committee on the Diagnosis and Pathology of Nutritional Deficiencies of the National Research Council have been complied with (Jolliffe, McLester, and Sherman, *21*). This committee recommended that the signs of nutritional disturbances be listed as such without any implication as to their interpretation as far as etiology is concerned.

METHODS USED

Each year of the study the examinations were first made in the Control School and were started approximately 1 month later in the Lunch School. All physical examinations in 1947 were made by one clinician. Another clinician observed his methods at that time and then made the examinations in 1948. The children appeared for their physical examinations in no known order as far as their participation in the school lunch program was concerned. Neither of these examiners was aware of the extent to which the children participated in the school

lunch since this information was obtained from the school records after the study was completed.

The methods used in the physical examinations have been described by Sandstead and Anderson (*37*). Eleven items were examined in each case for a complete description of the eyes, mouth, and skin. The items were all graded from 0, showing the absence of any abnormality, through 3, which indicated a severe disturbance. For many of the items examined, there were very few children who showed even any minimal signs. These signs proved insignificant as a means of evaluating the school lunch program and for this reason the results presented have been limited to the selected signs and symptoms described in appendix B.

HEALTH STATUS

The frequency of appearance of the selected physical signs was practically the same in the two schools when each of the schools was considered as a whole, but the differences between the schools were inconsistent in relation to school lunch participation. For instance, in 1947 a larger proportion of the children in the Control School than in the Lunch School showed these signs while the reverse was true in 1948. In both schools children having school lunches showed more signs than children without school lunches. The variations between the schools were no greater than some of the differences between 1947 and 1948 in the same school. In the second year when both schools had a lunch program, certain signs such as folliculosis and thickening of the eyes, gingivitis, and some tongue signs were recorded to a much greater extent than during the first year of the study (table 6). The significance of the comparison of the physical signs between 1947 and 1948 is doubtful, however, because the examinations were made by two different physicians.

The physical symptoms noted vary with age group and with year of observation. In several categories the school lunch groups showed a higher percentage of children with signs suggestive of nutritional disturbances than the group without school lunches. In all cases, only the mildest forms of symptoms were seen and in some categories, the percent of children in the two groups was practically the same (tables 7 and 8). The similarity of values for groups with and without school lunches is all the more remarkable since the children appeared for examination in an order unknown to the physician.

The apparent inconsistencies in the clinical findings in 1948 as compared with 1947 emphasize the need for more objective methods of evaluating nutritional status. Among the 10- to 12-year-olds, in the Lunch School there was a higher incidence of folliculosis and tongue signs other than fissuring in the group with school lunches than in the group without. The poorer showing of the lunch group as far as physical signs are concerned, contrasts with the higher percentage of children in this group who were given an over-all physical rating of "good." Although there was considerable disparity in the sex distribution of these groups, some of them having twice as many boys as girls and vice versa, the distribution of the physical findings among these groups shows no indication that the physical findings are associated with the unequal sex distribution. (For a special analysis made on children 8, 9, and 10 years old, see p. 18.)

It should be emphasized that the children in the two schools were generally in good physical condition. Under such circumstances, it would be difficult to detect changes due to the school lunch. This is especially so, when it is realized that the nutritional status of children is affected by a number of factors in addition to food.

HEIGHT-WEIGHT STATUS

Heights and body weights were obtained for all children as soon as they reported to the clinic. These were taken without their shoes and outer garments. All weights were compared with the Baldwin-Wood Tables (*4*) to determine their deviation from the average (table 9).

In the Control School there was no difference between groups participating and not participating in the school lunch with respect to the proportion of children in the "average" weight category. When all degrees of weight deviation were combined, there were more overweight children in the group without school lunches and more underweight children in the school lunch group.

In the Lunch School the different weight categories were more evenly matched for the groups with and without school lunches but there was still a preponderance of underweight children in the group having a school lunch, especially in the groups that deviated 10 to 19 percent from the average.

No explanation is apparent for these findings. There is the possibility, however, that the high percentage of underweight children in the lunch group in both schools may reflect efforts made by school authorities to provide such children with a lunch, or that the overweight children not having lunch at school had diets excessive in calorie content.

Absenteeism

Absenteeism from school may be due to a number of factors. Insofar as poor attendance is due to illness, it is a reflection of poor general health. For this reason it is desirable to know whether the number of days missed from school might be associated with school lunch participation.

The original plan did not call for a study of absenteeism. A year after the study was completed the school records were examined. The days absent from school are summarized in table 10 for those children on which other records were satisfactory.

No statistical difference was found in the rate of absenteeism in the groups with and without school lunches in either school in the two years. The average number of days away from school and the standard deviation were slightly lower in the Lunch School than in the Control School and lower in the Control School in 1948 after a lunch program was started than in 1947. In two out of three comparisons, rate of absenteeism was lower in the lunch group than in the group without school lunches. These findings emphasize the need for more thorough studies of absenteeism which would include the cause thereof, and if it is illness, the nature and duration of the illness.

The surprising feature of these findings is the relatively high rate of absenteeism in all groups. The values for the standard deviations reflect some high figures which appeared among both the groups participating and not participating in the school lunch. There was some

indication that those children who were out of school for a large part of one year were repeaters the following year, but the causes of the chronic absenteeism could not be ascertained.

Biochemical Examinations

For many years nutritionists have hoped that tests could be developed that would indicate the nutritional status of individuals based on the level of certain constituents of their blood or urine. Such methods would be more objective than direct clinical evaluations. Methods have recently been developed for the analysis of a number of blood constituents using minute quantities of blood, readily obtained from the fingertip, and hence make possible much more widespread use of chemical tests on blood samples from children. These methods have been used in this study.

METHODS USED

Blood samples were analyzed for hemoglobin, serum carotene, and serum ascorbic acid. Because some of these criteria show seasonal variations, data are presented for samples obtained in the spring of 1947 and 1948. In all cases nonfasting blood samples were used.

Free-flowing blood, required for hemoglobin determinations, was drawn directly into the hemoglobin pipette. Samples were transferred immediately to the acid solution for determination by the method of Cohen and Smith (*14*) with the modification that readings were made in a photoelectric colorimeter.

Blood samples for the other analyses were collected in melting point tubes, the ends were sealed with plicene, and samples returned to the laboratory. The tubes were centrifuged and samples of serum measured with appropriate constriction pipettes into 6 by 50 mm. tubes, stoppered, and stored in a freezing chamber at −20° C. until analyzed.

Carotene was estimated later by the micromethod of Bessey, Lowry, Brock, and Lopez (*9*).

Ascorbic acid analyses were begun the day the samples were collected and were completed that day or the samples were stored at −20° C. as trichloracetic acid filtrates until analyses could be completed, usually the next day. The microchemical method used was that of Lowry, Lopez, and Bessey (*25*) as modified by Bessey, Lowry, and Brock (*8*). This is a microadaptation of the Roe and Kuether dinitrophenylhydrazine method (*35*).

STANDARDS FOR INTERPRETATION OF FINDINGS

The interpretation of the analytical results is as important as the methods used in their determination. Bessey and Lowry (*7*), who developed the microchemical methods used in this study, have proposed a set of values indicative of nutritional adequacy, based on data scattered in the literature and recent experiences in their own laboratories. In the interpretation of the results of this study minor deviations from their standards have been used for reasons explained below.

With respect to the normal hemoglobin content of the blood the report of Kaucher and coworkers (*23*) has summarized the results

from many laboratories. This illustrates that the range of normal hemoglobin levels reported in healthy individuals is so wide that it is virtually impossible to establish a definite level below which a value can be considered pathologic.

That part of the reported variations in hemoglobin values may stem from errors in the analytical methods used, has been brought out by studies in which aliquots of the same two samples were analyzed by a number of different laboratories. The results showed a surprisingly high degree of variation in the hemoglobin values (*22*, *5*). One blood sample which had 9.8 gm. of hemoglobin per 100 ml. was reported to contain from 8 to 15 gm. by different analysts, with most of the values between 9 and 10. The other sample which had 15.1 gm. was reported as 12.5 to 18.0 gm., with most of the values between 14 and 16 (*5*). When variations in hemoglobin values reported by reputable clinical laboratories are as great as those in the above study, it is difficult to make interlaboratory comparisons.

With the techniques used in their laboratory, Osgood and Baker (*32*) considered hemoglobin values below 10.0 gm. per 100 ml. of blood as indicative of anemia. Values of 12.0 gm. and above were regarded as satisfactory by these workers and also by Pett and Ogilvie (*33*). As determined by Bessey and Lowry (*7*), hemoglobin values below 11 gm. were considered poor, 11 to 12.9 gm. fair, 13 to 13.9 gm. good, and 14 gm. and above excellent. Because of the lower range of distribution of the hemoglobin values in this study, three categories have been used to compare the groups with and without school lunch. They include children with levels below 12.0 gm. per 100 ml. of blood, 12.0 to 12.9 gm., and 13.0 gm. and above.

For the carotene content of the blood or blood serum, few data are available in the literature and the results are dependent upon the specific methods used for their determination. The three classifications used in this report for serum carotene values are: Below 70 μg.; 70 to 129 μg.; and 130 μg. and above.

For fasting serum ascorbic acid concentrations the report of the Committee on Vitamins of the American Academy of Pediatrics (*12*) suggests values of 0.2 mg. or less per 100 ml. as representing deficiency of this vitamin, and values of 0.6 mg. or more as satisfactory. Nonfasting blood samples were used in this study. Bessey, at the Detroit conference on Methods for Evaluating Nutritional Status of Mothers, Infants and Children (*13*, pp. 54–55) justified the use of such samples for survey work. He pointed out that for subjects who habitually had low vitamin C levels, a glass of orange juice for breakfast on the day the blood sample was drawn would raise the blood level at the most by 0.2 mg. per 100 ml. He stated that "except for the possibility of some median group members being raised to the top group, non-fasting samples are not a real handicap." For this study values used for low, intermediate, and upper groupings were: Below 0.4 mg., 0.4 to 0.5 mg., and 0.6 mg. or above.

RESULTS

Hemoglobin.—Table 11 gives hemoglobin levels for 1947 and 1948 for the children from the Control School, and table 12 for those from the Lunch School. The distribution of the values for the children in

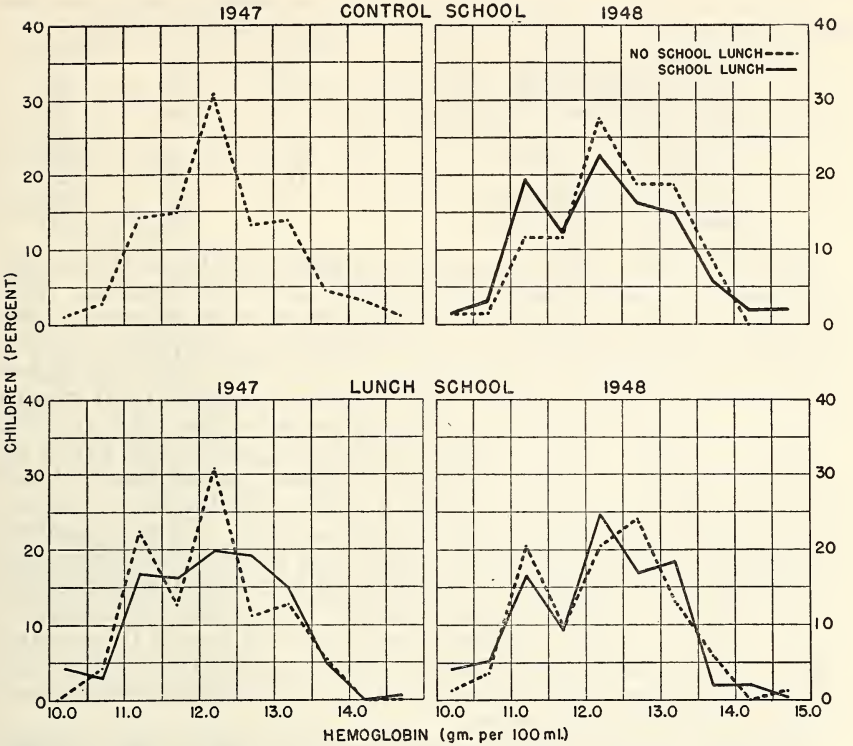

FIGURE 1.—Hemoglobin: Distributions of hemoglobin values for children by degree of school lunch participation, Control and Lunch Schools, 1947 and 1948.

the two schools is presented in figure 1. The average hemoglobin level for each group for both years was 12.3 gm. per 100 ml. Percentage distribution according to selected levels is given below:

School and group:	*Percent of children having hemoglobin values (gm. per 100 ml. of blood)—*		
	Below 12	*12.0 to 12.9*	*13.0 and above*
Control School:			
No school lunch, 1947	33	44	23
No school lunch, 1948	26	46	28
School lunch, 1948	36	39	25
Lunch School:			
No school lunch, 1947	40	42	18
School lunch, 1947	41	39	20
No school lunch, 1948	35	45	20
School lunch, 1948	35	42	23

On the basis of these analyses there is no evidence of advantage for the children receiving the school meal.

SERUM CAROTENE.—Values for 1947 and 1948 are summarized in tables 13 and 14. The percentage distribution for the children in the two schools is presented in figure 2. Percentage distribution according to the selected levels of content is given on the following page:

School and group:	Percent of children having serum carotene values (μg. per 100 ml. of blood)—		
	Below 70	*70 to 129*	*130 and above*
Control School:			
No school lunch, 1947	42	46	12
No school lunch, 1948	16	51	33
School lunch, 1948	6	54	40
Lunch School:			
No school lunch, 1947	31	44	25
School lunch, 1947	18	44	38
No school lunch, 1948	4	51	45
School lunch, 1948	2	51	47

For both schools, about the same percentage of children were in the intermediate category regardless of school lunch participation. The percent of children with serum carotene levels below 70 μg. was less in groups that partook of the school lunch than in groups that did not. The percent of children having values of 130 μg. and above was higher for those with than for those without school lunch. In all groups there was an increase in levels of serum carotene from 1947 to 1948.

Serum Ascorbic Acid.—Comparison of the ascorbic acid values by schools irrespective of participation in the school lunch program shows that fewer low values were found for children in the Lunch School than in the Control School both in 1947 and 1948 (tables 15 and 16 and fig. 3). In 1947 the Control School had 56 and 22 percent of the children with serum ascorbic acid below 0.4 and above 0.6 mg., respectively. In 1948, after the school lunch was introduced, the proportions were reversed, 22 percent below 0.4, and 55 percent 0.6 mg. and above. Thus, the Control School in 1948 compared favorably with the Lunch School, with 56 and 63 percent in 1947 and 1948, respectively, in the high level group.

The distribution of serum ascorbic acid values in the three selected levels arranged according to participation of the children in the school lunch program is given below:

School and group:	Percent of children having serum ascorbic acid values (mg. per 100 ml. of blood)—		
	Below 0.4	*0.4 to 0.5*	*0.6 and above*
Control School:			
No school lunch, 1947	56	22	22
No school lunch, 1948	34	25	41
School lunch, 1948	15	24	61
Lunch School:			
No school lunch, 1947	37	24	39
School lunch, 1947	22	14	64
No school lunch, 1948	26	27	47
School lunch, 1948	6	18	76

The classification into groups with and without a school lunch reveals greater differences between groups classified by years than between schools as a whole and shows more fully the advantage for the children having a school lunch. Since apparent improvements from 1947 to 1948 were found in both schools for the groups not participating in the school lunch and also for the school lunch group in the Lunch School, identical groups of children for both years were compared to see if the differences were due to shifts in children from one group to another, or if the ascorbic acid values were truly higher in 1948.

In table 17 the ascorbic acid values are shown for two groups from the Control School: Group A, the 59 children who were in the group without school lunches both in 1947 and 1948; and group B, the 157

children for whom no school lunch was available in 1947 but who participated in the lunch regularly in 1948. The other two groups were from the Lunch School: Group C, the 47 children who were in the group without school lunches both years; and group D, the 139 children who were in the school lunch group both years. The percentage distribution for these four groups, according to levels of ascorbic acid in serum is given below:

School and group:	*Percent of children having serum ascorbic acid values (mg. per 100 ml. of blood)—*		
	Below 0.4	*0.4 to 0.5*	*0.6 and above*
Control School:			
Group A (59 children):			
No school lunch, 1947	63	17	20
No school lunch, 1948	34	25	41
Group B (157 children):			
No school lunch, 1947	57	23	20
School lunch, 1948	15	24	61
Lunch School:			
Group C (47 children):			
No school lunch, 1947	36	17	47
No school lunch, 1948	28	32	40
Group D (139 children):			
School lunch, 1947	22	12	66
School lunch, 1948	4	19	77

This comparison reveals that the serum ascorbic acid values for all groups were higher in 1948 than in 1947. This is shown by the smaller percentages of children with values below 0.4 mg. in groups

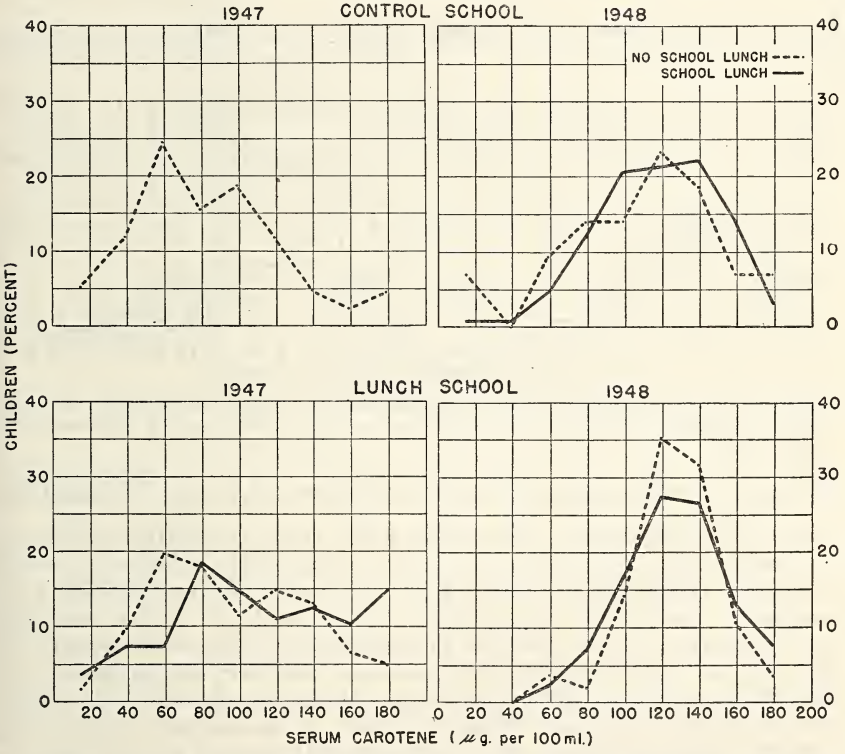

FIGURE 2.—Serum carotene: Distributions of carotene values for children by degree of school lunch participation, Control and Lunch Schools, 1947 and 1948.

A, C, and D in which there was no change in participation and by the larger percentages with values of 0.6 mg. and above in groups A and D. Group B, all of whom changed to full participation the second year, contained fewer children in 1948 than in 1947 with values below 0.4 mg. and proportionally more with values of 0.6 mg. and above. This improvement as well as that for group D reflects both an improved home diet and the influence of the school lunch. Such refinement of the sample indicates that the nature of the school lunch was a real factor in improving the serum ascorbic acid values of the children.

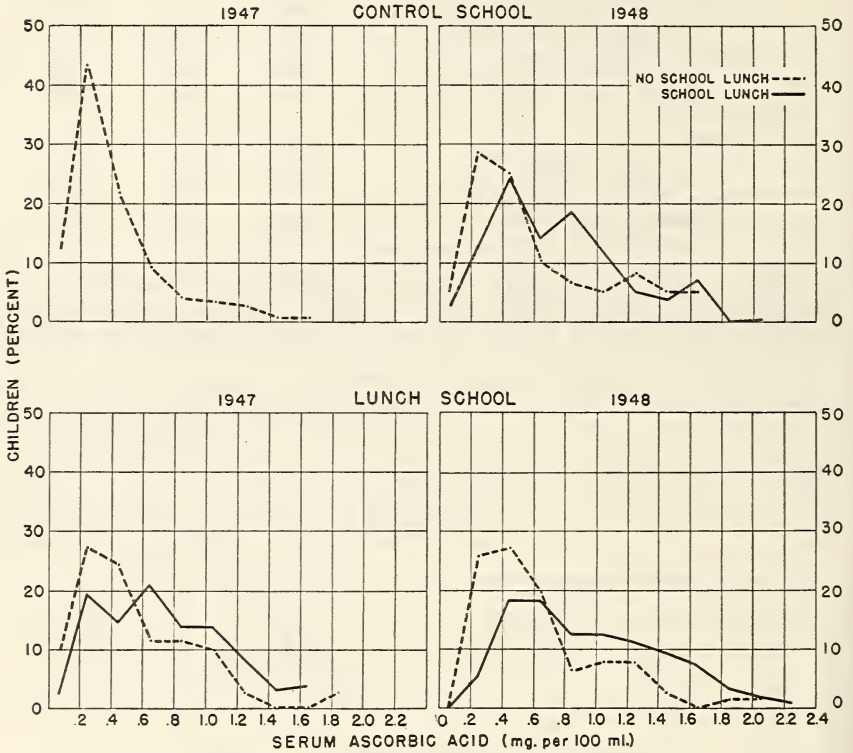

FIGURE 3.—Serum ascorbic acid: Distributions of ascorbic acid values for children by degree of school lunch participation, Control and Lunch Schools, 1947 and 1948.

PHYSICAL AND BIOCHEMICAL STATUS OF CHILDREN 8, 9, AND 10 YEARS OLD

In view of the high ascorbic acid levels among the children having a school lunch, it appeared desirable to determine whether a more complete breakdown of the sample for age and sex would show any consistent results for other examinations studied. It has already been brought out that nearly all the children had clinical examinations and physical measurements, but blood samples were not secured from all of them, and even fewer remained in the same school lunch participation group each year. Since the size of the samples was small, further subclassification could be made only among the children 8, 9, and 10 years old.

Table 18 shows the physical, clinical, and biochemical findings on 144 boys and girls, 8, 9, and 10 years of age who appeared in the same school lunch participating group both years at the time of the examinations. No records are available to show that they remained in the same group throughout the school year or in the years preceding this study.

It is obvious that the children in the group without school lunch tended to be taller and heavier than those in the school lunch group. However, comparison of the groups with and without a school lunch shows the year's average gains in height and weight were similar. In general appearance the boys in the nonparticipating groups rated higher and the girls rated the same or somewhat lower than corresponding groups with a school lunch. The incidence of other clinical signs were not consistent among the groups but tended to be more frequent in children having a school lunch. There were no consistent differences in hemoglobin levels. The children participating in the school lunch had higher levels of carotene and ascorbic acid in blood serum.

No satisfactory explanation of the above findings can be offered at this time. The subsamples are too small for generalizations. The participating boys and girls in this tabulation all belonged to the Lunch School where a lunch was available both years. On the other hand a larger proportion of the nonparticipating children belonged to the Control School. Findings in the dietary study (p. 49) showed that in 1948 children without a school lunch attending the Lunch School had poorer home diets than did children in the Control School who did not receive a school lunch.

TABLE 6.—PHYSICAL SIGNS: *Summary of percent of children with specified signs, by degree of school lunch participation, Control and Lunch Schools, 1947 and 1948*

Physical sign	1947			1948			
	Control School	Lunch School		Control School		Lunch School	
	No school lunch	No school lunch	School lunch	No school lunch	School lunch	No school lunch	School lunch
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Appearance:							
Poor	1	------	------	7	3	2	2
Fair	35	32	34	30	29	29	42
Good	64	68	66	63	69	68	56
Eyes:[1]							
Thickening	7	9	15	26	30	15	14
Folliculosis	28	18	19	44	34	35	41
Mouth:[1]							
Gingivitis	21	9	11	15	18	35	36
Tongue signs other than fissuring	6	6	4	11	27	43	55
Skin:[1]							
Xerosis and folliculosis	12	6	9	9	2	3	8

[1] Only minimal symptoms were seen.

TABLE 7.—PHYSICAL SIGNS: *Percent of children with specified signs, by degree of school lunch participation and age, Control School, 1947 and 1948*

Physical sign	1947			1948 [1]											
	No school lunch			All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
Appearance:	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Poor	0. 9	0. 9	0. 8	5. 6	5. 4	5. 9	7. 4	8. 9	4. 0	11. 1	8. 8	15. 0	3. 4	3. 0	4. 1
Fair	35. 2	36. 4	33. 1	28. 2	28. 8	27. 1	29. 6	30. 4	28. 0	24. 1	23. 5	25. 0	28. 8	29. 6	27. 4
Good	63. 9	62. 7	66. 1	66. 2	65. 8	67. 0	63. 0	60. 7	68. 0	64. 8	67. 7	60. 0	67. 8	67. 4	68. 5
Eyes: [2]															
Thickening	7. 1	3. 6	13. 6	27. 9	23. 0	37. 3	25. 9	21. 4	36. 0	22. 2	14. 7	35. 0	30. 2	25. 8	38. 4
Folliculosis	27. 8	29. 5	24. 6	40. 3	40. 5	39. 8	44. 4	41. 1	52. 0	59. 3	64. 7	50. 0	33. 7	34. 1	32. 9
Blepharitis	4. 7	4. 1	5. 9	2. 1	. 5	5. 1	------	------	------	3. 7	------	10. 0	2. 4	. 8	5. 5
Outer canthi lesions	. 6	. 9	------	2. 1	1. 4	3. 4	------	------	------	------	------	------	3. 4	2. 3	5. 5
Mouth: [2]															
Gingivitis	21. 0	17. 7	27. 1	16. 5	14. 4	20. 3	14. 8	16. 1	12. 0	13. 0	8. 8	20. 0	18. 0	15. 2	23. 3
Tongue fissuring	3. 3	3. 2	3. 4	4. 7	4. 1	5. 9	1. 2	------	4. 0	3. 7	2. 9	5. 0	6. 3	6. 1	6. 8
Other tongue signs	6. 5	6. 8	5. 9	21. 2	19. 4	24. 6	11. 1	12. 5	8. 0	14. 8	8. 8	25. 0	26. 8	25. 0	30. 1
Skin: [2]															
Xerosis and folliculosis	11. 5	10. 0	14. 4	2. 9	2. 7	3. 4	8. 6	7. 1	12. 0	------	------	------	1. 5	1. 5	1. 4
Number of children examined	338	220	118	340	222	118	81	56	25	54	34	20	205	132	73

[1] Based on age reported at time of examination, spring 1947.
[2] Only minimal symptoms were seen.

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TABLE 8.—PHYSICAL SIGNS: *Percent of children with specified signs, by degree of school lunch participation and age, Lunch School, 1947 and 1948*

Physical sign	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1947											
Appearance:	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Poor												
Fair	32. 7	34. 6	28. 1	32. 5	28. 6	42. 9	31. 3	37. 9	16. 0	33. 5	35. 8	28. 0
Good	67. 3	65. 4	71. 9	67. 5	71. 4	57. 1	68. 7	62. 1	84. 0	66. 5	64. 2	72. 0
Eyes: [1]												
Thickening	13. 9	11. 1	20. 8	9. 1	5. 4	19. 0	15. 7	13. 8	20. 0	15. 3	12. 5	22. 0
Folliculosis	17. 6	19. 2	13. 5	18. 2	21. 4	9. 5	14. 5	13. 8	16. 0	18. 8	20. 8	14. 0
Blepharitis	3. 9	3. 8	4. 3	2. 6	3. 6	------	2. 4	1. 7	4. 0	5. 3	5. 0	6. 0
Outer canthi lesions	------	------	------	------	------	------	------	------	------	------	------	------
Mouth: [1]												
Gingivitis	9. 4	8. 1	12. 5	9. 1	7. 1	14. 3	7. 2	6. 9	8. 0	10. 6	9. 2	14. 0
Tongue fissuring	6. 4	7. 3	4. 2	7. 8	8. 9	4. 8	6. 0	5. 2	8. 0	5. 9	7. 5	2. 0
Other tongue signs	3. 9	4. 7	2. 1	6. 5	7. 1	4. 8	1. 2	1. 7	------	4. 0	4. 9	2. 0
Skin: [1]												
Xerosis and folliculosis	8. 5	8. 5	8. 3	6. 5	5. 4	9. 5	9. 6	8. 6	12. 0	8. 8	10. 0	6. 0
Number of children examined	330	234	96	77	56	21	83	58	25	170	120	50

[1] Only minimal symptoms were seen.

TABLE 8.—PHYSICAL SIGNS: *Percent of children with specified signs, by degree of school lunch participation and age, Lunch School, 1947 and 1948*—Continued

Physical sign	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1948 [2]											
Appearance:	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Poor	1. 8	1. 7	2. 1	2. 3	1. 6	3. 7	-------	-------	-------	2. 0	2. 1	1. 8
Fair	36. 0	38. 1	30. 9	29. 2	25. 8	37. 0	23. 9	28. 1	14. 3	41. 8	45. 5	32. 1
Good	62. 2	60. 2	67. 0	68. 5	72. 6	59. 3	76. 1	71. 9	85. 7	56. 2	52. 4	66. 1
Eyes: [1]												
Thickening	13. 7	14. 2	12. 4	14. 6	16. 1	11. 1	8. 7	6. 2	14. 3	14. 4	15. 2	12. 5
Folliculosis	40. 2	40. 6	39. 2	34. 8	30. 6	44. 4	47. 8	46. 9	50. 0	40. 8	43. 4	33. 9
Blepharitis	4. 2	4. 6	3. 1	5. 6	4. 8	7. 4	4. 3	6. 2	-------	3. 5	4. 1	1. 8
Outer canthi lesions	2. 7	1. 7	5. 2	2. 2	-------	7. 4	-------	-------	-------	3. 5	2. 8	5. 4
Mouth: [1]												
Gingivitis	36. 9	36. 8	37. 1	34. 8	33. 9	37. 0	45. 7	46. 8	42. 8	35. 8	35. 9	35. 7
Tongue fissuring	8. 0	6. 3	12. 4	5. 6	3. 2	11. 1	10. 9	9. 4	14. 3	8. 5	6. 9	12. 5
Other tongue signs	51. 8	48. 5	59. 8	42. 7	37. 1	55. 6	56. 5	59. 4	50. 0	54. 7	51. 0	64. 3
Skin: [1]												
Xerosis and folliculosis	6. 5	5. 9	8. 2	3. 4	4. 8	-------	6. 5	3. 1	14. 3	8. 0	6. 9	10. 7
Number of children examined	336	239	97	89	62	27	46	32	14	201	145	56

[1] Only minimal symptoms were seen.
[2] Based on age reported at time of examination, spring 1947.

TABLE 9.—DEVIATION FROM AVERAGE WEIGHTS FOR HEIGHTS:[1] *Percentage distribution of children, by degree of school lunch participation and age, Control and Lunch Schools, 1948*

Level of deviation from average weight for height[2]	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	Control School											
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100
30 percent and more underweight												
20–29 percent underweight	2	1	3					3	5	2	1	4
10–19 percent underweight	11	10	13	16	11	28	3	3	5	11	11	10
5–9 percent underweight	18	17	19	10	12	4	4	18	40	19	20	18
Average ±4 percent	40	43	36	39	46	24	39	41	35	41	42	39
5–9 percent overweight	11	11	9	16	18	12	13	17	5	8	8	10
10–19 percent overweight	10	11	9	10	5	20	9	15		11	12	8
20–29 percent overweight	4	4	3	4	4	4	6			4	4	4
30 percent and more overweight	4	3	8	5	4	8	26	3	10	4	2	7
Number of children examined	340	222	118	81	56	25	54	34	20	205	132	73

[1] Based on Baldwin-Wood tables (*4*).
[2] Age groups based on age at time of examination in 1947, but deviations based on actual age and measurements in 1948.

TABLE 9.—DEVIATION FROM AVERAGE WEIGHTS FOR HEIGHTS:[1] *Percentage distribution of children, by degree of school lunch participation and age, Control and Lunch Schools, 1948*—Continued

Level of deviation from average weight for height[2]	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	Lunch School											
All levels	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100
30 percent and more underweight												
20–29 percent underweight	1	1	1				2	3		2	1	2
10–19 percent underweight	15	14	18	11	10	15	7	6	7	18	18	21
5–9 percent underweight	20	22	16	19	19	18	24	25	21	20	22	14
Average ±4 percent	32	32	29	36	37	34	26	28	22	30	32	28
5–9 percent overweight	11	13	8	11	15	4	15	19	7	10	10	11
10–19 percent overweight	15	12	20	17	16	18	20	16	29	13	10	18
20–29 percent overweight	2	2	3				6	3	14	2	2	2
30 percent and more overweight	4	4	5	6	3	11				4	5	4
Number of children examined	336	239	97	89	62	27	46	32	14	201	145	56

[1] Based on Baldwin-Wood tables (4).
[2] Age groups based on age at time of examination in 1947, but deviations based on actual age and measurements in 1948.

TABLE 10.—RATES OF ABSENTEEISM FROM SCHOOL: *Number of children and average days absent, Control and Lunch Schools, 1947 and 1948*

Year and school	No school lunch			School lunch		
	Number of children	Number of days absent per child		Number of children	Number of days absent per child	
		Mean	Standard deviation		Mean	Standard deviation
1947:						
Control School	286	13. 6	±12. 68	-------	-------	-------
Lunch School	79	12. 1	±11. 08	174	9. 5	±8. 80
1948:						
Control School	81	9. 0	±9. 03	205	11. 0	±11. 54
Lunch School	89	8. 8	±9. 15	201	7. 5	±8. 85

TABLE 11.—HEMOGLOBIN LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Control School, 1947 and 1948*

Hemoglobin level (gm./100 ml.)	1947 [1]			1948 [2]											
	No school lunch			All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Under 10.5	1. 1	1. 7	------	2. 3	3. 7	------	1. 5	2. 2	------	7. 0	11. 1	------	1. 6	2. 5	------
10.5 to 10.9	2. 9	3. 5	1. 9	2. 3	3. 7	------	1. 5	2. 2	------	------	------	------	3. 2	5. 0	------
11.0–11.4	14. 3	13. 8	15. 1	16. 7	18. 3	13. 9	11. 6	13. 3	8. 3	13. 9	14. 8	12. 5	19. 3	21. 0	16. 2
11.5–11.9	15. 0	16. 7	12. 3	12. 7	13. 6	11. 1	11. 6	13. 3	8. 3	16. 3	14. 8	18. 7	12. 3	13. 5	10. 3
12.0–12.4	30. 7	33. 3	26. 4	23. 1	24. 6	20. 4	27. 5	33. 3	16. 7	18. 6	29. 7	------	22. 5	20. 2	26. 5
12.5–12.9	13. 2	13. 2	13. 2	16. 4	15. 2	18. 5	18. 8	15. 6	25. 0	13. 9	11. 1	18. 7	16. 0	16. 0	16. 2
13.0–13.4	13. 9	12. 6	16. 0	16. 4	13. 6	21. 3	18. 8	13. 4	29. 2	18. 6	14. 8	25. 0	15. 0	13. 5	17. 6
13.5–13.9	4. 6	4. 0	5. 7	6. 4	5. 2	8. 3	8. 7	6. 7	12. 5	4. 7	3. 7	6. 3	5. 9	5. 0	7. 3
14.0–14.4	3. 2	1. 2	6. 6	2. 0	1. 6	2. 8	------	------	------	4. 7	------	12. 5	2. 1	2. 5	1. 5
14.5 and over	1. 1	------	2. 8	1. 7	. 5	3. 7	------	------	------	2. 3	------	6. 3	2. 1	. 8	4. 4
Number of children examined	280	174	106	299	191	108	69	45	24	43	27	16	187	119	68

[1] No school lunch program in 1947.
[2] Based on age reported at time of examination, spring 1947.

TABLE 12.—HEMOGLOBIN LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Lunch School, 1947 and 1948*

Hemoglobin level (gm./100 ml.)	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1947											
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100
Under 10.5	2. 6	3. 7	-------	-------	-------	-------	1. 4	2. 0	-------	4. 2	5. 9	-------
10.5–10.9	2. 9	4. 1	-------	4. 2	5. 9	-------	1. 4	2. 0	-------	3. 0	4. 2	-------
11.0–11.4	18. 4	21. 9	9. 9	22. 5	27. 5	10. 0	17. 8	24. 0	4. 3	16. 9	18. 7	12. 5
11.5–11.9	16. 5	17. 8	13. 2	12. 7	15. 7	5. 0	20. 5	24. 0	13. 1	16. 3	16. 1	16. 7
12.0–12.4	24. 2	23. 7	25. 2	31. 0	29. 4	35. 0	27. 4	28. 0	26. 1	19. 9	19. 5	20. 8
12.5–12.9	17. 1	16. 0	19. 8	11. 3	9. 8	15. 0	17. 8	14. 0	26. 1	19. 3	19. 5	18. 8
13.0–13.4	13. 2	9. 6	22. 0	12. 7	7. 8	25. 0	9. 6	6. 0	17. 4	15. 0	11. 9	22. 9
13.5–13.9	4. 5	3. 2	7. 7	5. 6	3. 9	10. 0	2. 7	-------	8. 7	4. 8	4. 2	6. 2
14.0–14.4	. 3	1. 1	-------	-------	-------	-------	1. 4	-------	4. 3	. 6	-------	-------
14.5 and over	. 3	1. 1	-------	-------	-------	-------	-------	-------	-------	-------	-------	2. 1
Number of children examined	310	219	91	71	51	20	73	50	23	166	118	48
	1948 [1]											
All levels	100	100	100	100	100	100	100	100	100	100	100	100
Under 10.5	3. 1	4. 0	1. 0	1. 2	1. 8	-------	2. 3	3. 2	-------	4. 1	5. 0	1. 8
10.5–10.9	4. 4	5. 3	2. 1	3. 6	5. 4	-------	2. 3	3. 2	-------	5. 1	5. 8	3. 6
11.0–11.4	17. 8	20. 8	10. 5	20. 5	23. 2	14. 8	18. 2	19. 4	15. 4	16. 5	20. 1	7. 3
11.5–11.9	10. 3	10. 6	9. 5	9. 6	12. 5	3. 7	15. 9	19. 4	7. 7	9. 3	7. 9	12. 7
12.0–12.4	24. 0	29. 2	11. 6	20. 5	25. 0	11. 1	27. 2	32. 2	15. 4	24. 7	30. 2	10. 9
12.5–12.9	18. 4	12. 8	31. 6	24. 1	19. 6	33. 4	13. 6	-------	46. 1	17. 0	13. 0	27. 3
13.0–13.4	17. 1	14. 2	24. 2	13. 3	10. 7	18. 5	18. 2	19. 4	15. 4	18. 6	14. 4	29. 1
13.5–13.9	2. 8	1. 8	5. 3	6. 0	1. 8	14. 8	-------	-------	-------	2. 1	2. 2	1. 8
14.0–14.4	1. 2	. 4	3. 2	-------	-------	-------	-------	-------	-------	2. 1	. 7	5. 5
14.5 and over	. 9	. 9	1. 0	1. 2	-------	3. 7	2. 3	3. 2	-------	. 5	. 7	-------
Number of children examined	321	226	95	83	56	27	44	31	13	194	139	55

[1] Based on age reported at time of examination, spring 1947.

TABLE 13.—SERUM CAROTENE LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Control School, 1947 and 1948*

Serum carotene level (μg./100 ml.)	1947 [1]			1948 [2]											
	No school lunch			All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Under 30	5. 3	5. 8	4. 4	2. 0	2. 4	1. 4	7. 0	7. 7	5. 9	------	------	------	0. 8	1. 2	------
30–49	11. 9	9. 7	15. 5	1. 0	. 8	1. 4	------	------	------	3. 6	------	8. 3	. 8	1. 2	------
50–69	24. 6	24. 0	25. 6	6. 1	5. 6	6. 8	9. 3	11. 5	5. 9	7. 1	6. 2	8. 3	4. 8	3. 7	6. 8
70–89	15. 6	16. 9	13. 3	13. 2	13. 7	12. 3	14. 0	19. 2	5. 9	17. 9	25. 0	8. 3	11. 9	9. 8	15. 9
90–109	18. 8	18. 2	20. 0	18. 8	21. 8	13. 7	14. 0	19. 2	5. 9	17. 9	18. 8	16. 7	20. 6	23. 2	15. 9
110–129	11. 9	15. 6	5. 6	21. 8	17. 8	28. 8	23. 2	7. 7	47. 0	21. 4	18. 8	25. 0	21. 4	20. 7	22. 7
130–149	4. 9	2. 6	8. 9	21. 8	23. 4	19. 2	18. 6	15. 5	23. 5	25. 0	25. 0	25. 0	22. 2	25. 6	15. 9
150–169	2. 5	. 7	5. 6	11. 7	11. 3	12. 3	6. 9	11. 5	------	7. 1	6. 2	8. 3	14. 3	12. 2	18. 2
170 and over	4. 5	6. 5	1. 1	3. 6	3. 2	4. 1	7. 0	7. 7	5. 9	------	------	------	3. 2	2. 4	4. 6
Number of children examined	244	154	90	197	124	73	43	26	17	28	16	12	126	82	44

[1] No school lunch program in 1947.
[2] Based on age reported at time of examination, spring 1947.

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TABLE 14.—SERUM CAROTENE LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Lunch School, 1947 and 1948*

Serum carotene level (μg./100 ml.)	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1947											
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100
Under 30	3. 1	1. 1	8. 2	1. 6	-------	5. 6	3. 1	2. 3	5. 0	3. 6	1. 0	11. 4
30–49	7. 7	4. 8	15. 1	9. 9	4. 6	22. 2	6. 3	2. 3	15. 0	7. 4	5. 9	11. 4
50–69	12. 3	10. 1	17. 8	19. 7	18. 6	22. 2	15. 6	11. 4	25. 0	7. 4	5. 9	11. 4
70–89	15. 3	16. 5	12. 3	18. 0	20. 9	11. 1	6. 3	9. 1	-------	18. 4	17. 8	20. 0
90–109	13. 0	13. 8	11. 0	11. 5	16. 3	-------	10. 9	11. 4	10. 0	14. 7	13. 9	17. 2
110–129	13. 4	14. 9	9. 6	14. 7	16. 3	11. 1	17. 2	13. 6	25. 0	11. 0	14. 9	-------
130–149	13. 4	14. 9	9. 6	13. 1	13. 9	11. 1	15. 6	18. 1	10. 0	12. 5	13. 9	8. 6
150–169	8. 8	10. 6	4. 1	6. 6	4. 7	11. 1	7. 8	9. 1	5. 0	10. 3	13. 9	-------
170 and over	13. 0	13. 3	12. 3	4. 9	4. 7	5. 6	17. 2	22. 7	5. 0	14. 7	12. 8	20. 0
Number of children examined	261	188	73	61	43	18	64	44	20	136	101	35
	1948 [1]											
All levels	100	100	100	100	100	100	100	100	100	100	100	100
50–69	3. 4	3. 1	3. 9	3. 5	5. 1	-------	9. 4	9. 1	10. 0	2. 0	1. 0	4. 1
70–89	5. 5	3. 1	10. 4	1. 8	-------	5. 6	6. 2	9. 1	-------	6. 8	3. 0	14. 3
90–109	15. 7	16. 4	14. 3	14. 0	15. 4	11. 1	12. 5	13. 6	10. 0	17. 0	17. 3	16. 4
110–129	27. 5	23. 9	35. 0	35. 1	25. 7	55. 5	15. 6	4. 6	40. 0	27. 2	27. 6	26. 5
130–149	26. 7	29. 6	20. 8	31. 6	35. 9	22. 2	18. 8	22. 7	10. 0	26. 5	28. 6	22. 4
150–169	12. 7	14. 5	9. 1	10. 5	15. 4	-------	15. 6	13. 6	20. 0	12. 9	14. 3	10. 2
170 and over	8. 5	9. 4	6. 5	3. 5	2. 5	5. 6	21. 9	27. 3	10. 0	7. 6	8. 2	6. 1
Number of children examined	236	159	77	57	39	18	32	22	10	147	98	49

[1] Based on age reported at time of examination, spring 1947.

TABLE 15.—SERUM ASCORBIC ACID LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Control School, 1947 and 1948*

Serum ascorbic acid level (mg./100 ml.)	1947 [1]			1948 [2]											
	No school lunch			All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
0.1 or under	12.6	11.3	14.7	3.5	1.2	7.4	5.1	2.6	10.0	5.1	------	13.3	2.5	1.0	5.0
0.2–0.3	43.5	41.3	47.4	18.4	17.5	20.0	28.8	28.2	30.0	25.6	20.8	33.3	12.8	12.4	13.3
0.4–0.5	22.0	21.2	23.2	23.1	20.7	27.4	25.4	17.9	40.0	15.4	16.7	13.3	24.2	22.7	26.7
0.6–0.7	9.4	11.3	6.3	12.6	12.5	12.6	10.2	12.8	5.0	10.3	12.5	6.7	14.0	12.4	16.7
0.8–0.9	4.3	5.0	3.2	15.7	15.6	15.8	6.8	7.7	5.0	18.0	16.6	20.0	18.5	18.5	18.3
1.0–1.1	3.9	5.0	2.1	9.0	9.4	8.4	5.1	7.7	------	5.1	8.3	------	11.5	10.3	13.3
1.2–1.3	2.7	3.1	2.1	6.3	7.5	4.2	8.4	10.3	5.0	7.7	12.5	------	5.1	5.2	5.0
1.4–1.5	.8	.6	1.0	4.3	6.3	1.0	5.1	7.7	------	5.1	4.2	6.7	3.8	6.2	------
1.6–1.7	.8	1.2	------	6.3	8.1	3.2	5.1	5.1	5.0	5.1	4.2	6.7	7.0	10.3	1.7
1.8 and over	------	------	------	.8	1.2	------	------	------	------	2.6	4.2	------	.6	1.0	------
Number of children examined	255	160	95	255	160	95	59	39	20	39	24	15	157	97	60

[1] No school-lunch program in 1947.
[2] Based on age reported at time of examination, spring 1947.

TABLE 16.—SERUM ASCORBIC ACID LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Lunch School, 1947 and 1948*

Serum ascorbic acid level (mg./100 ml.)	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1947											
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100	100	100	100	100
0.1 or under	5. 0	4. 3	6. 7	10. 0	10. 0	10. 0	5. 6	4. 1	8. 7	2. 5	1. 8	4. 3
0.2–0.3	21. 9	24. 2	16. 7	27. 1	28. 0	25. 0	22. 2	22. 4	21. 8	19. 5	23. 2	10. 6
0.4–0.5	16. 6	16. 1	17. 8	24. 3	24. 0	25. 0	13. 9	14. 3	13. 0	14. 5	13. 4	17. 0
0.6–0.7	17. 6	17. 1	18. 9	11. 4	12. 0	10. 0	16. 6	14. 3	21. 8	20. 8	20. 5	21. 3
0.8–0.9	13. 3	13. 7	12. 2	11. 4	10. 0	15. 0	13. 9	12. 3	17. 4	13. 8	16. 1	8. 5
1.0–1.1	11. 3	11. 4	11. 1	10. 0	12. 0	5. 0	6. 9	10. 2	-------	13. 8	11. 6	19. 2
1.2–1.3	8. 0	7. 1	10. 0	2. 9	2. 0	5. 0	12. 5	12. 3	13. 0	8. 2	7. 1	10. 6
1.4–1.5	3. 0	2. 4	4. 4	-------	-------	-------	5. 6	6. 1	4. 3	3. 1	1. 8	6. 4
1.6–1.7	2. 3	2. 8	1. 1	-------	-------	-------	1. 4	2. 0	-------	3. 8	4. 5	2. 1
1.8 and over	1. 0	. 9	1. 1	2. 7	2. 0	5. 0	1. 4	2. 0	-------	-------	-------	-------
Number of children examined	301	211	90	70	50	20	72	49	23	159	112	47

TABLE 16.—SERUM ASCORBIC ACID LEVELS: *Percentage distribution of children, by degree of school lunch participation and age, Lunch School, 1947 and 1948*—Continued

Serum ascorbic acid level (mg./100 ml.)	All groups			No school lunch			Occasional school lunch			School lunch		
	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years	All ages	6 to 9 years	10 to 12 years
	1948 [1]											
All levels	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100	*Pct.* 100
0.1 or under	.7	.5	1.1	-------	-------	-------	4.8	3.4	7.7	-------	-------	-------
0.2–0.3	12.9	11.9	15.5	26.0	30.1	16.7	21.4	6.9	53.8	5.5	5.4	5.7
0.4–0.5	23.2	23.2	23.3	27.3	26.4	29.1	38.1	41.4	30.8	18.2	17.8	18.9
0.6–0.7	16.3	15.2	18.9	19.5	18.9	20.8	2.4	3.4	-------	18.2	16.3	22.7
0.8–0.9	10.0	10.9	7.8	6.4	5.7	8.3	4.8	6.9	-------	12.6	14.0	9.4
1.0–1.1	12.3	11.8	13.3	7.8	5.7	12.5	19.0	24.2	7.7	12.6	11.6	15.1
1.2–1.3	9.0	10.4	5.6	7.8	9.4	4.2	2.4	3.4	-------	11.0	12.4	7.5
1.4–1.5	7.3	7.6	6.7	2.6	1.9	4.2	7.1	10.4	-------	9.3	9.3	9.4
1.6–1.7	4.3	5.2	2.2	-------	-------	-------	-------	-------	-------	7.1	8.5	3.8
1.8 and over	4.0	3.3	5.6	2.6	1.9	4.2	-------	-------	-------	5.5	4.7	7.5
Number of children examined	301	211	90	77	53	24	42	29	13	182	129	53

[1] Based on age reported at time of examination, spring 1947.

TABLE 17.—SERUM ASCORBIC ACID LEVELS: *Percentage distribution of selected children according to school lunch participation in 1947 and 1948*

Serum ascorbic acid level (mg./100 ml.)	Control School				Lunch School			
	Group A		Group B		Group C		Group D	
	No school lunch, 1947	No school lunch, 1948	No school lunch, 1947	School lunch, 1948	No school lunch, 1947	No school lunch, 1948	School lunch, 1947	School lunch, 1948
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
All levels	100	100	100	100	100	100	100	100
0. 1 and under	11. 9	5. 1	11. 5	2. 5	8. 5	------	2. 9	------
0. 2–0. 3	50. 8	28. 8	45. 2	12. 8	27. 7	27. 7	19. 4	4. 3
0. 4–0. 5	17. 0	25. 4	22. 9	24. 2	16. 9	31. 9	12. 2	18. 7
0. 6–0. 7	11. 8	10. 2	7. 0	14. 0	14. 9	8. 5	21. 6	19. 5
0. 8–0. 9	3. 4	6. 8	4. 5	18. 5	14. 9	8. 5	15. 1	12. 9
1. 0–1. 1	3. 4	5. 1	2. 5	11. 5	8. 5	10. 7	13. 7	12. 9
1. 2–1. 3	------	8. 4	4. 5	5. 1	4. 3	8. 5	8. 6	13. 7
1. 4–1. 5	------	5. 1	1. 3	3. 8	------	2. 1	3. 6	7. 9
1. 6–1. 7	1. 7	5. 1	. 6	7. 0	------	------	2. 9	6. 5
1. 8–1. 9	------	------	------	------	4. 3	------	------	2. 2
2. 0–2. 1	------	------	------	. 6	------	2. 1	------	. 7
2. 2–2. 3	------	------	------	------	------	------	------	. 7
Number of children examined	59	59	157	157	47	47	139	139

TABLE 18.—*Physical and biochemical status of children 8, 9, and 10 years old, with same degree of school lunch participation in 1947 and 1948* [1]

Group and year	Number of children	Average for group			Clinical findings						Blood chemistry		
		Age	Height	Weight	General appearance		Eyes		Gums	Skin	Hemoglobin	Serum carotene	Serum ascorbic acid
					Good	Fair	Thickening	Follicolosis	Gingivitis	Xerosis or follicolosis			
Boys, 1947:													
Participating—		*Yr. Mo.*	*In.*	*Lb.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Gm./100ml.*	*μg./100ml.*	*Mg./100ml.*
8 years old	13	8 4	50	57	38	62	8	23	8	16	12. 1	95	0. 74
9 years old	16	9 5	53	68	44	56	6	19	6	31	12. 4	108	. 66
10 years old	12	10 7	54	74	67	33	17	8	8	25	12. 5	95	. 82
Nonparticipating—													
8 years old	13	8 3	51	59	77	23	------	31	23	------	12. 0	97	. 46
9 years old	12	9 4	53	68	83	17	17	25	42	17	12. 6	75	. 41
10 years old	10	10 6	57	84	50	50	30	30	40	30	12. 8	83	. 49
Boys, 1948:													
Participating—													
9 years old	13	9 4	52	62	46	54	8	31	46	54	12. 2	122	. 81
10 years old	16	10 6	54	76	38	[2] 56	19	25	44	62	12. 5	121	. 82
11 years old	12	11 7	56	81	59	[2] 33	17	25	25	42	12. 6	114	. 88
Nonparticipating—													
9 years old	13	9 3	51	61	69	31	23	15	23	------	12. 5	126	. 82
10 years old	12	10 4	54	77	75	25	25	42	42	50	12. 4	82	. 50
11 years old	10	11 6	59	95	60	40	30	20	10	30	12. 6	120	. 63
Girls, 1947:													
Participating—													
8 years old	15	8 6	49	56	67	33	20	27	------	13	12. 0	118	. 50
9 years old	10	9 3	52	61	80	20	------	30	10	10	12. 4	134	. 65
10 years old	14	10 5	53	64	64	36	14	29	7	7	12. 2	120	. 74
Nonparticipating—													
8 years old	9	8 7	50	56	67	33	------	33	11	11	12. 4	113	. 67
9 years old	11	9 6	54	68	73	27	------	27	------	------	12. 1	84	. 34
10 years old	9	10 6	56	73	56	44	33	------	11	------	12. 1	75	. 49

Girls, 1948:														
Participating—														
9 years old	15	9	5	51	61	53	47	27	47	60	53	12.0	154	.84
10 years old	10	10	3	54	66	60	40	10	60	40	40	12.3	132	1.01
11 years old	14	11	5	55	73	64	36	7	57	29	------	12.2	131	.91
Nonparticipating—														
9 years old	9	9	4	51	61	67	33	11	44	11	22	12.2	141	.80
10 years old	11	10	7	55	78	73	[2] 18	18	36	18	18	12.1	124	.54
11 years old	9	11	6	58	87	44	56	11	56	------	22	12.9	111	.44

[1] This tabulation includes data only for those children who had the specified examination for both years.
[2] Does not include one case rated *Poor*.

SCHOOL LUNCHES SERVED

Samples of school lunches as served to fourth to sixth grade children were taken for chemical analyses. Calculated estimates of the nutritive value of the meals were also made. Methods of collection, preparation, and analysis of the samples are described in appendix C.

In order to get a picture of the actual nutritive value of the school meals and their variability, samples from the Lunch School were collected for two periods of 10 days each during February and March 1947. Inspection of the data showed a wide daily variation, but an average of the values (except for ascorbic acid) for any 3 consecutive days eliminated these variations nearly as well as averages for 5 or 10 consecutive days (table 19). Therefore, the average of 3 consecutive days was considered sufficiently representative of foods served in this situation.

In 1948 three lunches were collected from each school including children in the study: The Lunch School on May 11, 12, and 13; the school to which children from the Control School had been transferred (see p. 4) on May 14, 17, and 18; and the Control School on May 19, 20, and 21.

Description of Lunches

The foods served, weights per serving for the fourth to sixth grade children, and the results of the chemical analyses and calculated estimates of the nutritive values for 29 meals collected are given in table 20.

The school lunch pattern developed to meet the requirements of the type A lunch under the National School Lunch Program calls for the following foods: ½ pint of whole milk as a beverage; 2 ounces of lean meat, poultry, fish, or cheese, or one egg, or ½ cup (cooked measure) of dry beans, peas, or soybeans, or 4 tablespoons of peanut butter; ¾ cup of vegetables or fruit or both; one or more portions of bread or muffins or other hot bread made of whole-grain or enriched flour or cereal; 2 teaspoons of butter or fortified margarine. It is permissible to meet the protein requirement by serving one-half the quantities of each of two of the protein-rich foods.

The menus as served in the schools studied consisted of a main dish containing a high-protein food, most often ground meat in some form; vegetables served in combination with the meat in soups or stews, or as a raw salad, or as a buttered cooked vegetable; and a dessert such as fruit, fruit juices and cookies, puddings, or ice cream. Citrus concentrates were provided in generous amounts through the U. S. Department of Agriculture after March 1947 and were served about three times a week during the time of this study. In addition, bread and fortified margarine and milk were served regularly. The bread was varied somewhat—white or whole-wheat bread or a combination of the two in a sandwich, raisin bread, or corn bread was served in the meals analyzed. Chocolate milk was served half the time during the period of observation in 1946–47, but in 1947–48 only "plain" milk was served and was well accepted.

The first- and second-grade children received somewhat smaller helpings than the older children, but all children were allowed "seconds" if desired. Some variation was made in the size of servings at the request of individual children, but all were encouraged to take at least small helpings of unfamiliar foods or foods they professed to dislike. Seconds were served only after the complete meal had been eaten. In general, second servings for children from fourth to sixth grades more than overbalanced any plate waste so that the values (table 20) represent the average eaten by 9- to 12-year-old children.

Nutrient Content of Lunches

The analytical data from these 29 meals in the amounts served to the older children are summarized in figure 4. Each dot represents the value for a meal. The values found by analysis are indicated as percentages of the daily dietary allowances recommended by the National Research Council for the 10- to 12-year-old child. Since the

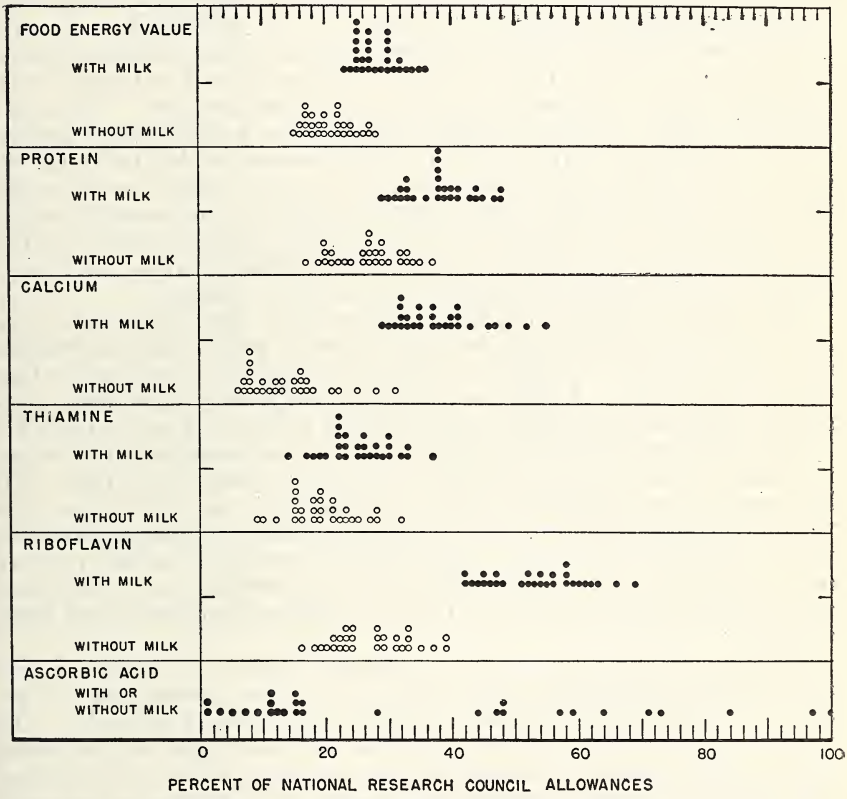

Figure 4.—Nutritive values of 29 school lunches as related to the National Research Council's recommended daily dietary allowances for children 10 to 12 years old.

milk used as a beverage was analyzed separately from the rest of the meal, the nutritive value of meals for children refusing to drink milk is also illustrated in the chart.

Although the food energy values of the lunches ranged from 25 to 35 percent of recommended daily allowances, these figures take no account of seconds of bread which were always available, nor of vegetables and protein foods, seconds of which were also usually available. As a result, some children doubtless obtained a higher percentage of their energy needs from the lunch. The majority of the complete meals with milk met 30 to 45 percent of the protein, 30 to 50 percent of the calcium, and 40 to 65 percent of the riboflavin allowances. Without milk as a beverage many of the protein and riboflavin values and all the calcium values were below one-third of these allowances. Most of the thiamine values in the complete meals ranged from 20 to 30 percent of the allowances; only four values were more than 30 percent.

The ascorbic acid values varied from 1 to more than 100 percent of the daily recommended allowances. Only one meal containing citrus products furnished less than 44 percent. The grapefruit juice used in that meal (Feb. 17, 1947) had been on the cafeteria shelves for a long time, and was bitter in taste. Only one meal without citrus products contained more than 16 percent of the allowance. This meal (May 14, 1948) included 132 gms. tomato juice and 34 gms. coleslaw but still contained only 28 percent of the recommended daily allowance. This illustrates the fact that tomato juice cannot be depended upon as a substitute for citrus juices to supply a generous quantity of ascorbic acid. The meals were generally well prepared, and the retention of vitamins during preparation probably was as good as or better than the average for foods prepared in quantity.

Since the average of analyzed values for 3 days appeared to be representative of the nutritive values for the school meals served in the Lunch School, comparisons were made of the calculated values on the same basis. A summary of the average values for three consecutive days for analytical and calculated values is given in table 21.

The calculated values for calories, protein, calcium, and fat are not markedly or consistently different from the analyzed values. All but one of the calculated values for riboflavin are lower than the values from analysis, however. On the other hand, calculated thiamine values are 0.03 to 0.18 mg. higher than the analyzed values, in spite of an attempt to correct for cooking losses in calculations. Calculated ascorbic acid values are from 5 to 31 mg. higher than the values from analysis.

Use of calculated rather than analyzed figures for thiamine and ascorbic acid, therefore, could easily give a false impression of adequacy for the amount of these important vitamins in the meals. The margin of differences between analyzed and calculated values makes it desirable to plan lunches calculated to contain at least one-half of the National Research Council's allowances for thiamine and ascorbic acid until better tables are available for values for cooked foods.

TABLE 19.—*Comparison of average analyzed nutrient content of school meals for periods of 3, 5, 10, and 20 days, 1947*

Number of days in average	Dates	Food energy	Protein	Fat	Calcium	Thiamine	Riboflavin	Ascorbic acid
		Cal.	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
3	February 17–19	810	26. 1	25. 5	492	0. 37	1. 10	8
	February 20–24	636	25. 9	23. 9	426	. 31	1. 04	8
	February 25–27	761	25. 1	31. 0	426	. 28	1. 04	6
	March 17–19	692	26. 9	24. 0	412	. 26	. 94	16
	March 20–24	656	27. 7	24. 5	448	. 31	. 96	42
	March 25–27	622	26. 4	25. 0	415	. 25	. 92	31
5	February 17–21	743	26. 6	25. 3	481	. 35	1. 09	7
	February 24–28	719	25. 0	28. 3	435	. 30	1. 02	13
	March 17–21	681	27. 3	23. 8	431	. 27	. 96	20
	March 24–28	648	27. 8	26. 3	458	. 29	. 97	34
10	February 17–28	731	25. 8	26. 8	458	. 32	1. 06	10
	March 17–28	664	27. 6	25. 1	445	. 28	. 96	27
20	February and March 17–28 combined.	698	26. 7	25. 9	451	. 30	1. 01	19

TABLE 20.—*Menus and nutritive value of 29 school lunches served, spring 1947 and 1948* [1]

Date	Food served				
	Main dish	Vegetable	Fruit or dessert	Bread and margarine	Milk
1947	*Gm. per serving*	*Gm. per serving*	*Gm. per serving*	*Gm. per serving*	*Gm. per serving*
Feb. 17	Spaghetti with meat sauce. 188	Beets 49 Lettuce salad. 56	Grapefruit juice. 132 Cookies 16	Bread and margarine. 52	Chocolate 240
Feb. 18	Bean soup with bacon. 280	Celery stick. 10	Fruit betty 88	Corn bread and margarine. 73	Plain 240
Feb. 19	Frankfurter sandwich. 75	Spinach 90 Sweetpotato and apples. 114	Prunes 89	----------	Chocolate 240
Feb. 20	Vegetable soup. 238 Meat sandwich. 74	Carrot stick. 10	Chocolate pudding. 79	----------	Plain 240
Feb. 21	Cottage cheese. 62 Hard-cooked egg. 28	Green beans. 71	Ice cream 66	Bread and margarine. 49	Plain 240
Feb. 24	Chiliburger. 98	Tossed salad. 44 Buttered peas. 52	Apples 113	----------	Chocolate 240
Feb. 25	Kidney bean salad. 88 ½ hard-cooked egg. 23	Buttered potato. 91	Fruit jello 113	Bread and margarine. 50	Chocolate 240
Feb. 26	Noodles with meat, cheese, and vegetables. 134	Pickled beets. 63 Tossed salad (cabbage carrots, and celery). 61	Gingerbread and pineapple. 78	Bread and margarine. 54	Plain 240
Feb. 27	Noodle soup with meat. 202	Carrot sticks. 11 Celery 9	Ice cream 51	Crackers 11 Bread, peanut butter, and margarine. 59	Plain 240
Feb. 28	Baked lima beans. 104 Cheese sticks. 18	Coleslaw 56 Carrot sticks. 10	Orange juice 94 Cookies 17	Bread and margarine. 52	Plain 240
Mar. 17	Spaghetti with meat sauce. 224	Lettuce salad. 43 Beets 46	Orange juice 88	Bread and margarine. 48	Chocolate 240
Mar. 18	Beef stew with vegetables. 238	Celery stick 15	Peaches 64 Apricots 38	Bread and margarine. 50	Chocolate 240
Mar. 19	Vegetable meat pie. 88	Waldorf salad. 79	Ice cream 66	Bread and margarine. 44	Chocolate 240
Mar. 20	Potato soup 219 Ham salad sandwich. 96	Carrot stick 22	Fruit jello 130		Chocolate 240
Mar. 21	Baked fish 108	Coleslaw 61 Creamed potato. 100	Orange juice 85 Cookies 14	Bread and margarine. 47	Plain 240
Mar. 24	Chiliburger 105	Buttered peas. 68 Tossed salad 72	Orange 170	----------	Chocolate 240
Mar. 25	Spanish rice with hamburger. 120	Coleslaw 49	Orange juice 90 Cookies 16	Bread and margarine. 46	Chocolate 240

See footnote 1, p. 42.

TABLE 20.—*Menus and nutritive value of 29 school lunches served, spring 1947 and 1948*—Continued

Date	Nutritive value of food served													
	Food energy		Protein		Fat		Calcium		Thiamine		Riboflavin		Ascorbic acid	
	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated
1947	*Cal.*	*Cal.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Feb. 17	885	836	31.1	24.6	25.7	35.5	425	343	0.40	0.34	1.24	0.62	12	60
Feb. 18	740	880	26.8	27.2	19.4	40.7	590	430	.44	.69	.93	.69	1	3
Feb. 19	804	673	20.4	21.2	31.5	14.2	462	363	.27	.35	1.14	.70	11	21
Feb. 20	667	696	28.1	26.6	21.5	24.2	449	476	.40	.40	1.12	.76	11	15
Feb. 21	620	602	26.5	30.7	28.4	30.1	479	477	.24	.29	1.04	.92	2	5
Feb. 24	622	554	23.0	19.6	21.9	16.9	350	325	.30	.34	.95	.59	10	19
Feb. 25	626	862	21.3	32.0	30.8	25.2	382	439	.32	.63	.94	.79	9	11
Feb. 26	762	783	26.3	23.5	18.8	35.8	488	412	.28	.42	1.09	.68	8	21
Feb. 27	896	719	27.6	31.1	43.5	34.6	409	398	.23	.33	1.08	.69	1	4
Feb. 28	687	729	26.8	22.7	26.4	22.6	547	546	.36	.36	1.06	.73	36	82
Mar. 17	743	784	26.5	25.0	24.1	34.8	398	358	.31	.35	.98	.60	33	51
Mar. 18	582	678	23.1	24.0	20.0	21.9	369	346	.26	.30	.85	.58	11	13
Mar. 19	750	709	31.0	19.4	27.8	24.7	469	426	.20	.30	.99	.65	4	8
Mar. 20	656	822	22.2	28.2	23.8	13.4	478	515	.31	.43	.97	.90	7	10
Mar. 21	672	888	33.5	43.7	23.6	38.6	443	477	.26	.48	1.00	.80	43	82
Mar. 24	639	611	27.5	22.4	26.1	17.8	422	385	.36	.48	.91	.66	75	103
Mar. 25	627	823	22.2	25.0	23.2	28.6	365	370	.27	.37	.84	.67	44	67

TABLE 20.—*Menus and nutritive value of 29 school lunches served, spring 1947 and 1948* [1]—Continued

Date	Food served				
	Main dish	Vegetable	Fruit or dessert	Bread and margarine	Milk
	Gm. per serving	*Gm. per serving*	*Gm. per serving*	*Gm. per serving*	*Gm. per serving*
Mar. 26	Vegetable soup. 214 Frankfurter sandwich. 83	Carrot sticks. 21	Chocolate pudding. 81	Crackers 10	Plain 240
Mar. 27	Macaroni with hamburger, kidney beans, and tomato. 97	Lettuce salad. 33	Orange jello with orange slices. 120	Bread and margarine. 47	Plain 240
Mar. 28	Lima bean soup. 200	Carrot stick 18 Celery 25	Bread pudding with raisins. 116	Bread and margarine. 48 Crackers 10	Plain 240
1948					
May 11	Frankfurters. 30	Sauerkraut. 52 Mashed potato. 135	Baked apple with nuts and raisins. 65	Bread and margarine. 55	Plain 240
May 12	Baked beans. 103 Cheese wedge. 25	Coleslaw with peppers and celery. 44	Grapefruit juice. 154 Cookies 14	Jam sandwich on whole wheat bread. 80	Plain 240
May 13	Beef stew. 232		Butterscotch pudding. 108	Raisin bread and margarine. 60 Crackers 8	Plain 240
May 14	Macaroni with cheese. 214 Hard-cooked egg. 25	Tomato juice. 132 Coleslaw 34	Dried peaches. 57	Raisin bread. 34	Plain 240
May 17	Chili con carne. 238	Carrot sticks. 10 Celery 8	Grapefruit juice. 148 Fruit jello and topping. 76	Crackers 8 Bread and margarine (½ whole wheat). 27	Plain 240
May 18	Vegetable meat pie. 185 Cheese wedge. 14	Cabbage salad. 42	Orange juice. 147 Cookies 13	Bread and margarine (½ whole wheat). 26	Plain 240
May 19	Meat loaf. 73	Buttered potatoes. 77 Breaded tomatoes. 56	Orange juice. 153 Jello and nuts. 95	Bread and margarine. 26	Plain 240
May 20	Baked beans with ½ frankfurter. 125 17	Coleslaw 42 Apples 65	Grapefruit juice. 151 Cooky 4	Bread and margarine. 26	Plain 240
May 21	Fish with tomato sauce. 78	Potato with parsley. 65 Green beans. 49	Orange juice. 150 Ice cream. 59	Bread and margarine. 32	Plain 240

[1] As served to fourth- to sixth-grade children. Smaller helpings of main dish and vegetables were served to children in first to third grades.

TABLE 20.—*Menus and nutritive value of 29 school lunches served, spring 1947 and 1948*—Continued

Date	Nutritive value of food served													
	Food energy		Protein		Fat		Calcium		Thiamine		Riboflavin		Ascorbic acid	
	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated
	Cal.	*Cal.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Mar. 26	635	716	31.4	30.2	26.0	23.4	494	475	0.22	0.33	1.04	0.77	12	15
Mar. 27	604	700	25.5	26.0	25.7	30.9	386	368	.26	.37	.87	.63	36	33
Mar. 28	736	834	32.6	28.1	30.3	26.6	625	494	.35	.52	1.19	.80	5	5
May 11	758	783	23.0	24.5	37.3	36.8	392	413	.31	.47	.76	.80	8	23
May 12	846	795	26.3	28.1	33.3	23.0	563	630	.28	.46	.83	.85	73	88
May 13	624	812	23.5	27.5	24.3	34.2	444	482	.17	.36	.75	.73	8	11
May 14	708	842	30.4	28.1	26.2	35.1	661	620	.28	.40	1.05	.99	21	49
May 17	797	992	33.7	44.5	33.9	42.0	385	445	.34	.59	.79	.80	35	56
May 18	819	735	28.0	26.0	41.3	26.9	492	541	.33	.45	.81	.75	53	96
May 19	769	764	28.9	28.2	34.7	29.3	388	425	.39	.50	.81	.65	55	83
May 20	670	595	22.0	21.7	28.7	18.1	418	392	.36	.37	.78	.67	63	88
May 21	685	691	28.7	32.5	24.7	30.8	511	464	.30	.38	1.01	.67	48	75

TABLE 21.—*Comparison of analyzed and calculated average nutritive values of school meals for 3-day periods, 1947 and 1948*

Dates	Food energy		Protein		Fat		Calcium		Thiamine		Riboflavin		Ascorbic acid	
	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated	Analyzed	Calculated
1947	*Cal.*	*Cal.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Feb. 17–19	810	796	26. 1	24. 3	25. 5	30. 1	492	379	0. 37	0. 46	1. 10	0. 67	8	28
20–24	636	617	25. 9	25. 6	23. 9	23. 7	426	426	. 31	. 34	1. 04	. 76	8	13
25–27	761	788	25. 1	28. 9	31. 0	31. 9	426	416	. 28	. 46	1. 04	. 72	6	12
Mar. 17–19	692	724	26. 9	22. 8	24. 0	27. 1	412	377	. 26	. 32	. 94	. 61	16	24
20–24	656	774	27. 7	31. 4	24. 5	23. 3	448	459	. 31	. 46	. 96	. 79	42	65
25–27	622	746	26. 4	27. 1	25. 0	27. 6	415	404	. 25	. 36	. 92	. 69	31	38
1948														
May 11–13	743	797	24. 3	26. 7	31. 6	31. 3	466	508	. 25	. 43	. 78	. 79	30	41
14–18	775	856	30. 7	32. 9	33. 8	34. 7	513	535	. 32	. 48	. 88	. 85	36	67
19–21	708	683	26. 5	27. 5	29. 4	26. 1	439	427	. 35	. 42	. 87	. 66	55	82

DIETS OF CHILDREN AND THEIR FAMILIES

Diets of Children

GROUPS STUDIED

In this section the diets of 63 children (nearly all 8 to 12 years old) attending the third to sixth grade in the Control School where no lunch was served are compared with the diets of 36 children attending the Lunch School and taking school lunches on 4 or 5 days during the week of their record in the spring of 1947. A comparison is also made for each school separately between the children with and without school lunches for the spring of 1948 when school lunches were served in the Control School.

The food each child consumed at home in meals and snacks was recorded by the child's mother for a continuous 7-day period in the spring of 1947, between May 5 and June 1. In the spring of 1948, between April 23 and May 28, the child's food intake for a 24-hour period prior to an interview was recalled by the mother. Since the dietary record obtained from the mother showed only the food eaten at home, an average portion of each food included in school lunches was added to the record for each day that the child had a school lunch. Account was also taken of the milk and ice cream which was bought and eaten. About one-third of the children at the Control School made such purchases. (Details for the method of collecting the child's food consumption by record and by recall are given in appendix D.)

The ratio of boys to girls was similar for the two groups compared (table 22). However, more younger boys (7 to 9 years old) and older girls (10 to 12 years old) were in the group with school lunch than in the group without school lunch.

FOODS CONSUMED, SPRING 1947

For ease in analyzing food consumption, foods have been classified into 11 groups on the basis of similar nutritive values and use in the diet. Average quantities of food consumed by a child in a day were converted to weight as brought into family and school kitchens, taking into account average refuse and changes in moisture content (table 23 and fig. 5).

Diets of children in the Lunch School were considerably higher in vegetables and milk products than diets of children in the Control School. About 60 percent of the children in the Lunch School had at least one large serving of green and yellow vegetables per day, whereas fewer than 15 percent of the children in the Control School had this amount. Each child in the Lunch School averaged at least 1 pint of milk daily (or its equivalent in milk products). Only about 75 percent of the children in the Control School had as much milk as this.

NUTRITIVE VALUE OF DIETS, SPRING 1947

The calculated nutritive value [3] of the diets of individual children indicates wide variation in relation to the National Research Council's

[3] Represents nutritive value of food brought into family and school kitchens before preparation for eating. See appendix D, p. 85, for source of nutritive values and for estimated cooking losses for four vitamins.

recommended allowances for calories and eight nutrients (tables 24 and 25). Cumulative frequency curves showing the percent of children that had diets furnishing as much as or more than any given number of calories or units of a nutrient indicate that diets were lower in relation to these allowances in calcium, ascorbic acid, and vitamin A value than other nutrients (fig. 6).

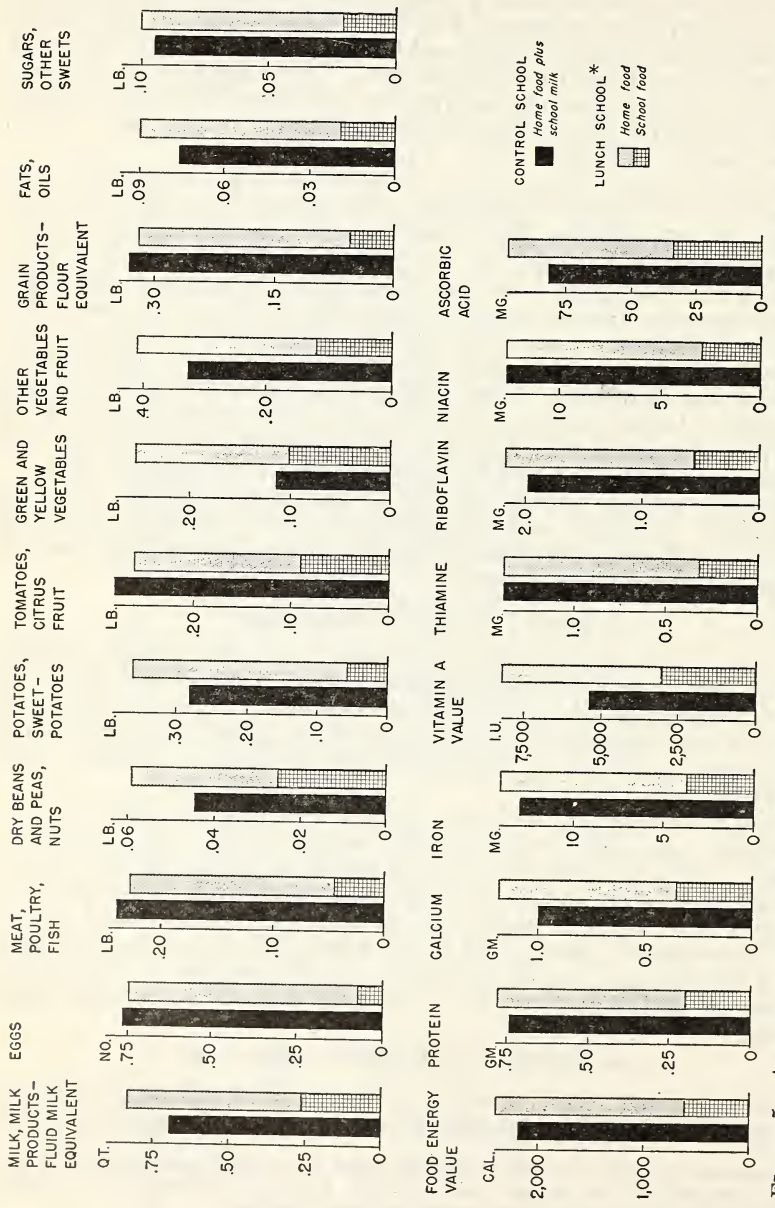

FIGURE 5.—Average quantity and nutritive value of home food and school food consumed per child per day, 1947.
*Children receiving 4 or 5 school lunches during week of food record.

Of special significance is the fact that practically none of the children in the Lunch School had diets as poor as some of the children in the Control School (fig. 6 and table 26). In the fall of 1946 dietary differences between comparable groups of children having and not having school lunches were similar to those found in the spring of 1947 (figs. 6 and 7). At the time of both studies (made by similar methods) the diets of the children in the Lunch School were better than those of the children in the Control School for every nutrient.

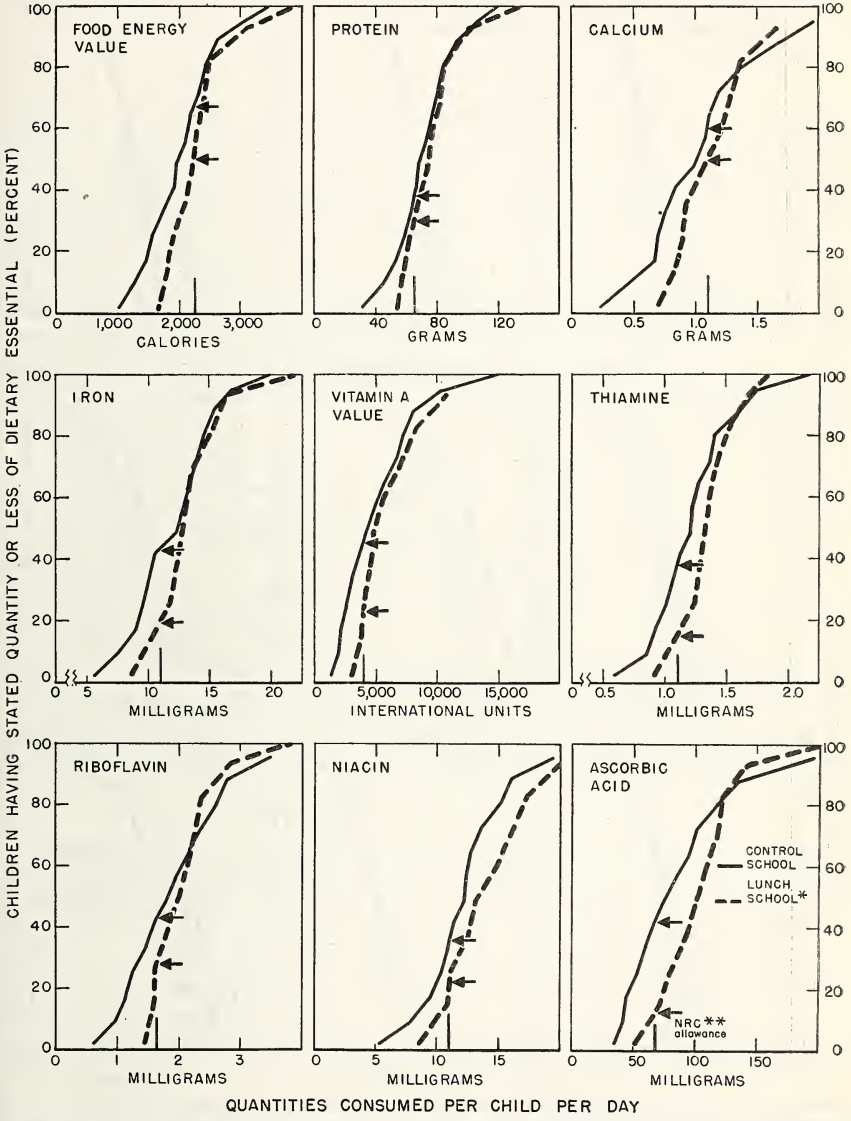

FIGURE 6.—Distribution of diets of children by calorie and nutrient content, spring 1947.

*Children receiving 4 or 5 school lunches during week of food record.
**Indicates National Research Council's recommended dietary allowance, average for 7–9 years and 10–12 years.

Between 20 and 25 percent of the children in the Control School had diets that failed to furnish at least two-thirds of allowances for calcium, ascorbic acid, and vitamin A value, whereas the diets of nearly all children in the Lunch School met two-thirds of allowances for each of these nutrients.

The higher calcium in the diets of children in the Lunch School reflected the higher milk content of their diets compared with those of children in the Control School (table 27). Similarly, differences

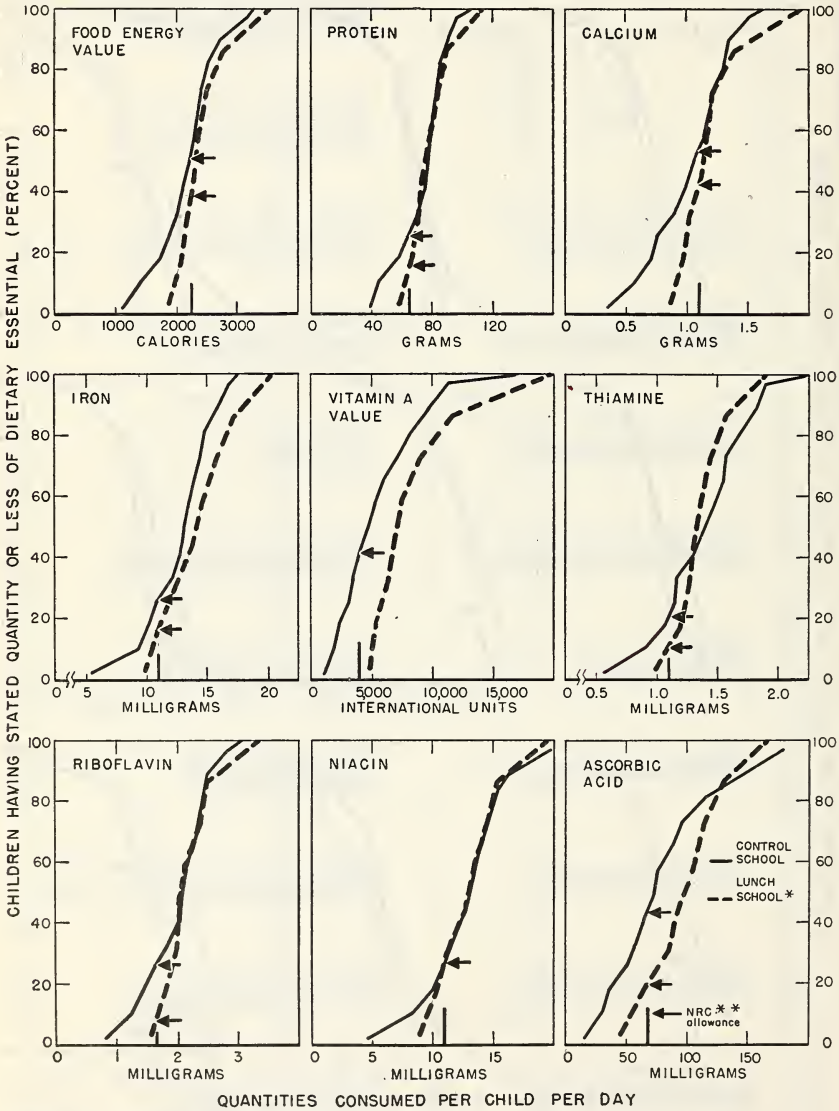

FIGURE 7.—Distribution of diets of children by calorie and nutrient content, fall 1946.

*Children receiving 4 or 5 school lunches during week of food record.
**Indicates National Research Council's recommended dietary allowance, average for 7–9 years and 10–12 years.

in ascorbic acid and vitamin A values were related to consumption of green and yellow vegetables.

When diets were graded by the nutrient meeting allowances least well, 7- to 9-year-old children had better diets than 10- to 12-year-old children and boys had better diets than girls (table 28). Also, children in families with monthly incomes of $250 or more, with four or fewer members, or with a homemaker who had had nine or more years of formal education, had better diets than children in families with lower incomes, with more household members, or with a homemaker who had had fewer years of formal education.

NUTRITIVE VALUE OF DIETS, SPRING 1948

Children in the Control School taking no school lunch during the spring of 1948 had diets that were similar in most nutrients to those found for children in that school during the previous spring when no lunch was offered. On the other hand the children receiving a school lunch in 1948 had better diets than in 1947 and diets better than those of children not participating in the school lunch. The figures below show that the children without a school lunch attending either school had diets about as short in the three least satisfactory nutrients in 1948 as in 1947 and that nearly all children with a school lunch had diets that furnished two-thirds or more of allowances:

Spring diets of children:	*Percent of diets furnishing 67 percent or more of NRC recommended allowances for—*		
With no school lunch:	*Calcium*	*Vitamin A value*	*Ascorbic acid*
Control School:			
1947 (63 7-day records)	78	79	77
1948 (60 1-day recalls)	75	80	75
Lunch School:			
1948 (48 1-day recalls)	70	75	65
With school lunch:			
Lunch School:			
1947 (36 7-day records)	100	100	97
1948 (68 1-day recalls)	100	100	99
Control School:			
1948 (59 1-day recalls)	100	100	99

From the above data it appears that children without a school lunch attending the Lunch School had poorer home diets than did children in the Control School who did not receive a school lunch in 1948.

SCHOOL LUNCHES, SPRING 1947

For children getting four or five school lunches per week, these lunches represented about one-fourth of the total number of home and school meals for the 7-day periods covered.[4] Figure 5 (also table 24) shows that in the spring of 1947, the average school lunch provided about one-third of the vitamin A value, ascorbic acid, and calcium in the diets of the children in the Lunch School and about one-fourth of the other essentials.

The three nutrients in which the school lunch made its greatest contribution to diets of the children in the Lunch School were the same

[4] In this comparison, the 3 meals of the day are assumed to be equal in nutritive value. The part of the food intake to assign to each of the 3 meals of the day is not known; among families there are wide differences and in any family there may be differences by day of week.

three nutrients in which diets of the children in the Control School were lowest—calcium, vitamin A value, and ascorbic acid. Milk products, tomatoes and citrus fruits, and green and yellow vegetables—foods which tended to be low in home diets—were used liberally in school lunches (fig. 5). The food groups used less in the school lunch—eggs, potatoes, and grain products—were used in relatively large quantities in the home diets of the children, particularly those of the children in the Lunch School.

Diets of Families, Spring 1947

Information on the home meals of the families of the children in the two schools indicating the kinds of home food supplies available to the children at the time of the dietary survey is valuable for persons concerned with improving meals served children at home and at school.

Details on the method of recording family food consumption are given in appendix D. In the analysis of family food consumption, families with children having and not having school lunches are combined for the Lunch School group.

FOODS CONSUMED

In table 29 quantities of foods consumed by families refer to the weight of food when brought into family kitchens from retail stores, freezer lockers, storage shelves, or garden, minus the estimated weight of foods that were discarded, given away, or fed to animals during the week of the record.

Consumption of potatoes and sweetpotatoes and of green and yellow vegetables was about 25 percent higher by families with children in the Lunch School than by those with children in the Control School. The former also used more cabbage and canned green beans, and slightly more of the foods in most other groups. The only food group used more by families with children in the Control School was fats and oils.

The larger consumption of food at home by families with children in the Lunch School was obtained at somewhat lower direct expense per person per week ($4.09) than that of those with children in the Control School ($4.27). Because a higher proportion of the families served by the Lunch School lived in the open country, they had more opportunity than the Control School families to have home-grown foods. (See fig. 9, p. 81, appendix D.) They produced more than 10 percent of their milk, meat, poultry, eggs, and vegetables and fruits. Families served by the Control School produced only 5 percent of their eggs and smaller quantities of the other foods.

NUTRITIVE VALUE OF DIETS

In the spring of 1947 diets of families served by both schools were more often low in calcium, ascorbic acid, and vitamin A value, compared with National Research Council's recommended dietary allowances (*30*), than in other nutrients (fig. 8).[5]

[5] In the fall of 1946 also, family diets were more often low in calcium, ascorbic acid, and vitamin A value than in other nutrients. About 25 percent of the fall diets contained less than two-thirds of the allowance for calcium and about 10 percent of the diets contained less than two-thirds of the allowances for ascorbic acid or vitamin A value.

As many as 40 percent of the families with children in either school had diets that failed to provide at least two-thirds of allowances for one or more nutrients. The greatest dietary difference between the two groups of families was in ascorbic acid, in which diets of the families in the Lunch School group were higher (table 30). In respect to other nutrients the diets were similar.

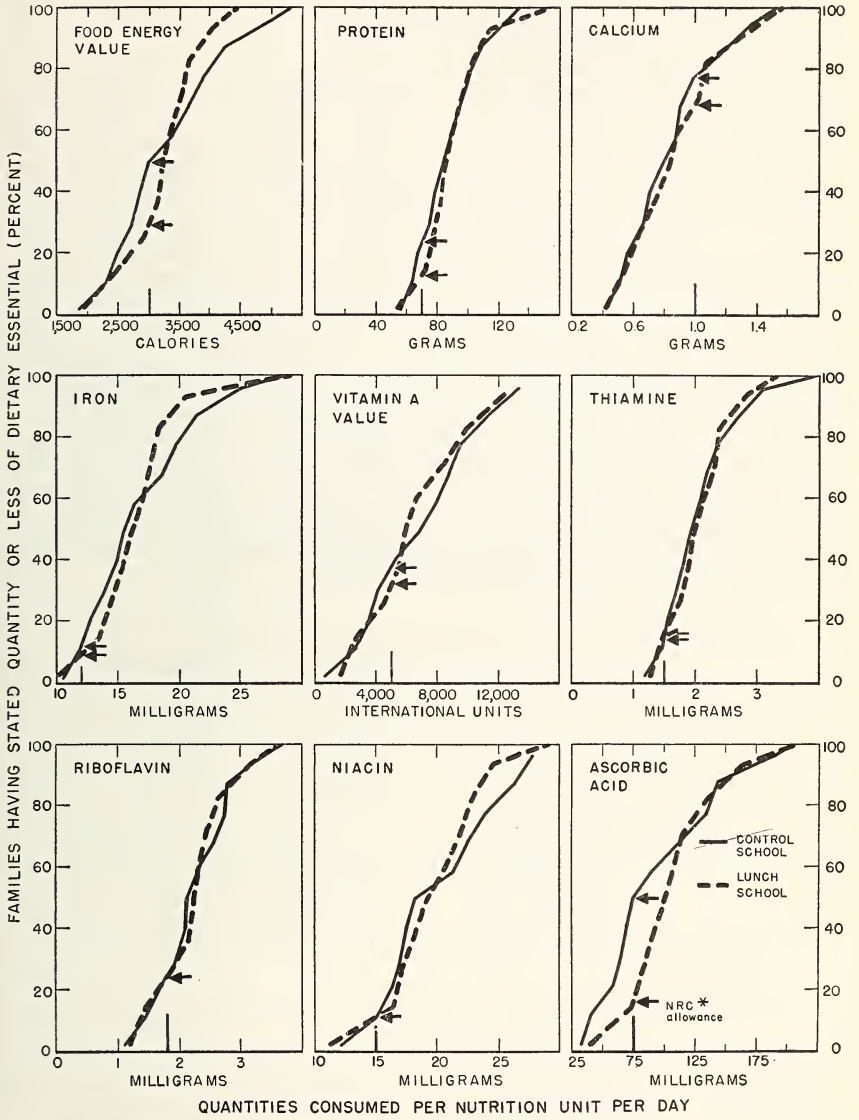

FIGURE 8.—Distribution of family diets by calorie and nutrient content, spring 1947.

*Indicates National Research Council's recommended dietary allowance for physically active man which is equal to one nutrition unit.

CHILDREN'S SHARE OF FAMILIES' DIETS

Compared with their families, the children in the Lunch School had diets in the spring of 1947 of much better quality in both calcium and vitamin A value and of similar quality in protein, ascorbic acid, and riboflavin. It will be recalled that school lunches contributed more calcium, vitamin A value, and ascorbic acid than home meals. Values for iron, thiamine, and niacin were lower on the average in the diets of the children than in those of their families.

In the spring of 1947, all food for child and family in the Control School group came from family food supplies, except milk and ice cream taken by a few children at school. The diets of most of the children, roughly 60 to 80 percent, were at about the same level of adequacy as their families' diets for all nutrients studied (table 31). Slightly more of the remaining children had poorer diets than the family as a whole for all nutrients except calcium. In calcium, about 30 percent of the children had diets of better quality than their families, about 60 percent had diets at the same level, and about 10 percent had diets of poorer quality. The higher calcium content of the children's diets is a result of their higher consumption of milk. Nearly 60 percent of the children had 1 pint or more of milk or its equivalent in ice cream, cheese, or other milk product per day, while less than 50 percent of the families had as much as this per person per day.

When the total diets of the children and their families are compared on the basis of the nutrient in least satisfactory supply, more than one-half of the children are found to have had diets at the same level as their families. The other one-half is about evenly divided between children with diets at a more satisfactory level and children with diets at a less satisfactory level than their families.

TABLE 22.—*Distribution of children by sex and age in dietary study, Control and Lunch Schools, fall 1946 and spring 1947 and 1948*

Sex and age	Children for whom specified type of food schedule was taken									
	7-day record				1-day recall					
	Fall 1946		Spring 1947		Spring 1947		Spring 1948			
							Control School		Lunch School	
	Control School (no school lunch)	Lunch School (school lunch)	Control School (no school lunch)	Lunch School (school lunch)	Control School (no school lunch)	Lunch School (school lunch)	No school lunch	School lunch	No school lunch	School lunch
	Number									
All children	64	[1] 44	63	[1] 36	68	39	60	59	48	68
Boys	33	23	34	21	31	16	31	31	18	42
7–9 years	13	12	9	9	10	6	10	9	7	14
10–12 years	20	11	21	11	19	10	20	19	10	28
13–15 years	0	0	4	1	2	0	1	3	1	0
Girls	31	21	29	15	37	23	29	28	30	26
7–9 years	22	7	14	4	15	11	6	6	10	10
10–12 years	9	13	15	11	19	11	20	20	19	12
13–15 years	0	1	0	0	3	1	3	2	1	4

[1] Excludes children having none or fewer than 4 school lunches during week of child's food record: 35 in fall 1946, 21 in spring 1947.

TABLE 22.—*Distribution of children by sex and age in dietary study, Control and Lunch Schools, fall 1946 and spring 1947 and 1948*—Continued

Sex and age	Children for whom specified type of food schedule was taken									
	7-day record				1-day recall					
	Fall 1946		Spring 1947		Spring 1947		Spring 1948			
							Control School		Lunch School	
	Control School (no school lunch)	Lunch School (school lunch)	Control School (no school lunch)	Lunch School (school lunch)	Control School (no school lunch)	Lunch School (school lunch)	No school lunch	School lunch	No school lunch	School lunch
	Percent									
All children	100	100	100	100	100	100	100	100	100	100
Boys	52	52	54	58	46	41	52	53	37	62
7–9 years	20	27	15	25	15	15	17	15	15	21
10–12 years	32	25	33	30	28	26	33	33	20	41
13–15 years	0	0	6	3	3	0	2	5	2	0
Girls	48	48	46	42	54	59	48	47	63	38
7–9 years	34	16	22	11	22	28	10	10	21	15
10–12 years	14	30	24	31	28	28	33	34	40	17
13–15 years	0	2	0	0	4	3	5	3	2	6

TABLE 23.—*Food consumption of children, Control and Lunch Schools, 1947* [1]

School and source of food	Children	Average quantity consumed per child per day: Milk, cream, ice cream, cheese [2]	Eggs	Meat, poultry, fish [3]	Dry beans and peas, nuts [4]	Potatoes, sweetpotatoes	Tomatoes, citrus fruits [5]	Green and yellow vegetables	Other vegetables and fruits [6]	Grain products [7]	Fats, oils [8]	Sugars, sweets
	No.	*Qt.*	*No.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Control School: [9]	63	0. 693	0. 760	0. 241	0. 045	0. 280	0. 281	0. 114	0. 326	0. 334	0. 076	0. 095
Lunch School: [10]												
All food	36	. 826	. 752	. 230	. 059	. 359	. 255	. 261	. 413	. 321	. 086	. 101
Food at home	36	. 558	. 672	. 184	. 033	. 300	. 165	. 158	. 292	. 264	. 066	. 080
Food at school	36	. 268	. 080	. 046	. 026	. 059	. 090	. 103	. 121	. 057	. 020	. 021
		Relative consumption (Control School=100)										
Lunch School:												
All food	-------	119	99	95	131	128	91	229	127	96	113	106

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, for third- to sixth-grade children.

[2] In terms of fluid whole milk equivalent; minerals and protein were taken into account in measuring fluid milk equivalents for evaporated milk, ice cream, cheese, and cream. Factors used for converting pounds of some milk products to quarts of their fluid milk equivalent are as follows: Evaporated milk, 0.94; ice cream, 0.56; cottage cheese, 1.40; cream cheese, 0.87; other cheese, 3.20.

[3] Excludes bacon and salt pork.

[4] Includes dry weight of cooked or canned dry beans, peas, and lentils. Includes shelled weight of nuts.

[5] Includes canned orange juice equivalent of concentrated orange juice, by weight.

[6] Includes fresh fruit equivalent of dried fruit, by weight.

[7] Includes two-thirds of weight of commercially baked goods added to weight of flours, meal, and cereals.

[8] Includes bacon and salt pork.

[9] School sold milk and ice cream only. Quantities include food eaten from family food supply plus any milk and ice cream eaten at school (recorded by mother).

[10] Children received 4 or 5 school lunches during week of food record. 24 percent of meals recorded were school lunches. All food includes food eaten from family food supply (recorded by mother) added to food in average lunch served at school (reported by school authorities) on days child had lunch at school.

TABLE 24.—*Nutritive value of children's diets, Control and Lunch Schools, 1947* [1]

School and source of food	Children	Average nutritive value of diets per child per day [2]								
		Food energy value	Protein	Calcium	Iron	Vitamin A value	Thiamine	Riboflavin	Niacin	Ascorbic acid
	No.	*Cal.*	*Gm.*	*Gm.*	*Mg.*	*I. U.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Control School [3]	63	2, 170	74	1. 016	12. 8	5, 490	1. 39	2. 00	13. 0	82
Lunch School: [4]										
All food	36	2, 400	78	1. 186	14. 1	8, 420	1. 39	2. 19	13. 3	98
Food at home	36	1, 780	58	. 820	10. 4	5, 310	1. 07	1. 62	10. 2	64
Food at school	36	620	20	. 366	3. 7	3, 110	. 32	. 57	3. 1	34
	Relative nutritive value (Control School = 100)									
Lunch School:										
All food		111	105	117	110	153	100	110	102	120

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, for third- to sixth-grade children.

[2] Represents nutritive value of food brought into family and school kitchens before preparation for eating.

[3] School sold milk and ice cream only. Averages include nutritive value of food eaten from family food supply plus any milk and ice cream eaten at school (recorded by mother).

[4] Children received 4 or 5 school lunches during week of food record. 24 percent of meals recorded were school lunches. All food includes food eaten from family food supply (recorded by mother) added to food in average lunch served at school (reported by school authorities) on days child had lunch at school.

TABLE 25.—*Distribution of diets of children by levels of food energy value and eight nutrients, Control and Lunch Schools, 1947* [1]

Nutrient	Control School [2]				Lunch School [4]			
	All diets	Diets furnishing specified percent of NRC recommended allowances [3]			All diets	Diets furnishing specified percent of NRC recommended allowances [3]		
		0–66	67–99	100 or more		0–66	67–99	100 or more
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Food energy value	100	14	46	40	100	0	47	53
Protein	100	5	27	68	100	0	19	81
Calcium	100	22	35	43	100	0	50	50
Iron	100	3	25	72	100	0	11	89
Vitamin A value	100	21	19	60	100	0	0	100
Thiamine	100	5	19	76	100	0	8	92
Riboflavin	100	6	19	75	100	0	14	86
Niacin	100	6	25	69	100	0	28	72
Ascorbic acid	100	23	27	50	100	3	17	80

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, for third- to sixth-grade children.

[2] Includes 63 children. School sold milk and ice cream only. Nutritive value of milk and ice cream eaten at school is included.

[3] Nutritive value of child's diet was related to recommended allowances of the National Research Council (1948), proper for age and sex, separately for food energy value and each of 8 nutrients. Quantities of dietary essentials covered by class intervals are shown in appendix table 33. Represents nutritive value of food brought into family and school kitchens before preparation for table.

[4] Includes 36 children who received 4 or 5 school lunches during week of food record. Nutritive value of school lunches is included.

TABLE 26.—*Distribution of diets of children by age and sex and by dietary levels for three nutrients, Control and Lunch Schools, 1947* [1]

Age and sex of child	Control School [2]					Lunch School [4]				
	All diets	Diets furnishing specified percent of NRC recommended allowances [3]				All diets	Diets furnishing specified percent of NRC recommended allowances [3]			
		All	0–66	67–99	100 or more		All	0–66	67–99	100 or more
	Calcium									
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Percent*	*Percent*
All children	63	100	22	35	43	36	100	0	50	50
Age group: [5]										
7 to 9 years	23	100	9	30	61	13	100	0	23	77
10 to 12 years	36	100	28	36	36	22	100	0	68	32
Sex:										
Girls	29	100	20	42	38	15	100	0	60	40
Boys	34	100	24	29	47	21	100	0	43	57
	Vitamin A value									
All children	63	100	21	19	60	36	100	0	0	100
Age group: [5]										
7 to 9 years	23	100	13	13	74	13	100	0	0	100
10 to 12 years	36	100	25	22	53	22	100	0	0	100
Sex:										
Girls	29	100	24	10	66	15	100	0	0	100
Boys	34	100	18	26	56	21	100	0	0	100

	Ascorbic acid									
All children	63	100	23	27	50	36	100	3	17	80
Age group: [5]										
7 to 9 years	23	100	13	13	74	13	100	0	0	100
10 to 12 years	36	100	25	33	42	22	100	5	23	72
Sex:										
Girls	29	100	21	28	51	15	100	7	27	66
Boys	34	100	24	26	50	21	100	0	10	90

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, for third- to sixth-grade children.

[2] School sold milk and ice cream only. Nutritive value of milk and ice cream eaten at school is included.

[3] Nutritive value of child's diet was related to recommended allowances of the National Research Council (1948), proper for age and sex, separately for each of the 3 nutrients. Quantities of dietary essentials covered by class intervals are shown in appendix table 33. Represents nutritive value of food brought into family and school kitchens before preparation for eating.

[4] Children received 4 or 5 school lunches during week of food record. Nutritive value of school lunches is included.

[5] Age at last birthday. 4 children in Control School and 1 child in Lunch School 13 to 15 years of age are omitted from classification by age.

TABLE 27.—*Contribution of foods to nutritive value of children's total diets and school lunches, Control and Lunch Schools, 1947* [1]

Nutrient and school	Average amount of each nutrient contributed per child per day by specified food group											
	All food	Milk, cream, ice cream, cheese	Eggs	Meat, poultry, fish [2]	Dry beans and peas, nuts	Potatoes, sweet-potatoes	Tomatoes, citrus fruits	Green and yellow vegetables	Other vegetables and fruits	Grain products	Fats, oils [3]	Sugars, sweets
	Home and school food [4]											
Food energy value:												
Control School [5]—cal.	2, 170	480	61	271	76	98	46	17	89	618	256	158
Lunch School [6]—cal.	2, 400	600	60	264	98	120	46	36	120	603	283	170
Protein:												
Control School—gm.	74	23	5	17	4	2	1	1	1	18	1	1
Lunch School—gm.	78	27	5	15	5	3	1	2	1	17	1	1
Calcium:												
Control School—gm.	1. 016	0. 789	0. 020	0. 012	0. 025	0. 012	0. 023	0. 015	0. 017	0. 094	0. 003	0. 006
Lunch School—gm.	1. 186	. 944	. 020	. 009	. 033	. 015	. 018	. 033	. 021	. 086	. 002	. 005
Iron:												
Control School—mg.	12. 8	. 6	1. 0	2. 6	1. 7	. 8	. 5	. 5	. 7	3. 9	. 1	. 4
Lunch School—mg.	14. 1	. 6	1. 0	2. 4	2. 3	1. 0	. 4	1. 2	. 9	3. 7	. 1	. 5
Vitamin A value:												
Control School—I. U.	5, 490	1, 208	434	571	11	203	472	1, 690	390	22	489	(7)
Lunch School—I. U.	8, 420	1, 415	429	387	17	51	488	4, 649	429	25	530	(7)
Thiamine:												
Control School—mg.	1. 39	0. 22	0. 04	0. 34	0. 08	0. 11	0. 06	0. 03	0. 05	0. 44	0. 02	(8)
Lunch School—mg.	1. 39	. 27	. 04	. 24	. 11	. 14	. 04	. 07	. 05	. 40	. 03	(8)
Riboflavin:												
Control School—mg.	2. 00	1. 10	. 13	. 27	. 04	. 04	. 03	. 03	. 05	. 28	. 01	. 02
Lunch School—mg.	2. 19	1. 31	. 13	. 21	. 05	. 05	. 02	. 08	. 07	. 25	. 01	. 01

Niacin:												
Control School—mg—	13.0	.7	(9)	4.5	.8	1.3	.4	.2	.5	4.4	.1	.1
Lunch School—mg—	13.3	.8	(9)	4.1	1.0	1.6	.4	.5	.7	.9	.2	.1
Ascorbic acid:												
Control School—mg—	82	7	(7)	1	1	16	39	8	10	(7)	(7)	(7)
Lunch School—mg—	98	7	0	1	1	18	37	24	10	(7)	0	(7)
	School food for children in Lunch School [6]											
Food energy value—cal—	620	215	7	62	43	19	19	14	34	109	64	34
Protein—gm—	20	9	1	4	2	(7)	(7)	1	(7)	3	(7)	(7)
Calcium—gm—	0.366	0.299	0.002	0.002	0.015	0.002	0.006	0.012	0.009	0.018	(10)	0.001
Iron—mg—	3.7	.2	.1	.6	1.1	.2	.1	.5	.3	.6	(8)	(8)
Vitamin A value—I. U—	3,110	470	51	0	8	(7)	143	2,145	143	(7)	150	(7)
Thiamine—mg—	0.32	0.08	0.01	0.04	0.04	0.02	0.01	0.03	0.01	0.08	(8)	(8)
Riboflavin—mg—	.57	.39	.01	.03	.02	.01	(8)	.03	.02	.06	(8)	(8)
Niacin—mg—	3.1	.2	(9)	.9	.5	.3	.1	.2	.2	.7	(9)	(9)
Ascorbic acid—mg—	34	1	0	(7)	(7)	3	16	11	3	0	0	(7)

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, for third- to sixth-grade children.
[2] Excludes bacon and salt pork.
[3] Includes bacon and salt pork.
[4] Represents nutritive value of food brought into family and school kitchens before preparation for eating. Includes food eaten from family food supply (recorded by mother). For Lunch School, also includes food in average lunch served at school (reported by school authorities) on days child had lunch.
[5] School sold milk and ice cream only. Nutritive value of milk and ice cream eaten at school is included.
[6] Children received 4 or 5 school lunches during week of food record. Nutritive value of school lunches is included. 24 percent of meals recorded were school lunches. [7] Less than 0.5. [8] Less than 0.005. [9] Less than 0.05. [10] Less than 0.0005.

TABLE 28.—*Over-all quality of children's diets in relation to age and sex of child, income and household size of family, and homemaker's education, Control and Lunch Schools, spring 1947 and fall 1946* [1]

Classification	Control School [2]					Lunch School [4]				
	All diets	Diets in which every nutrient provides at least specified percent of NRC recommended allowances [3]				All diets	Diets in which every nutrient provides at least specified percent of NRC recommended allowances [3]			
		All	0–66	67–99	100 or more		All	0–66	67–99	100 or more
	Spring 1947									
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
All children	63	100	100	40	33	27	36	100	100	3	64	33
Age: [5]												
7 to 9 years	23	37	100	21	26	53	13	36	100	0	38	62
10 to 12 years	36	57	100	47	39	14	22	61	100	5	77	18
Sex:												
Girls	29	46	100	45	24	31	15	42	100	7	80	13
Boys	34	54	100	35	41	24	21	58	100	0	52	48
Family net money income for a month:												
$249 or less	30	48	100	53	27	20	25	69	100	4	56	40
$250 or more	33	52	100	27	40	33	11	31	100	0	82	18
Household size in equivalent persons: [6]												
4 or fewer	31	49	100	32	23	45	21	58	100	5	62	33
5 or more	32	51	100	47	44	9	15	42	100	0	67	33
Years of formal education of homemaker:												
8 or fewer	31	49	100	55	32	13	14	39	100	7	72	21
9 or more	32	51	100	25	34	41	22	61	100	0	59	41

Fall 1946

All children	64	100	100	47	30	23	44	100	100	11	46	43
Age: [5]												
7 to 9 years	35	55	100	26	34	40	16	43	100	0	26	74
10 to 12 years	29	45	100	73	24	3	24	55	100	21	58	21
Sex:												
Girls	31	48	100	42	26	32	21	48	100	14	53	33
Boys	33	52	100	52	33	15	23	52	100	9	39	52
Family net money income for a month: [7]												
$249 or less	25	62	100	56	32	12	17	65	100	6	41	53
$250 or more	15	38	100	20	20	60	9	35	100	11	33	56
Household size in equivalent persons: [6]												
4 or fewer	34	53	100	32	32	36	24	55	100	21	41	38
5 or more	30	47	100	63	27	10	20	45	100	0	50	50
Years of formal education of homemakers:												
8 or fewer	35	55	100	53	23	14	21	48	100	10	52	38
9 or more	29	45	100	27	38	35	23	52	100	13	39	48

[1] Based on 7-day food records kept by mothers, May 5 to June 1, 1947, and Oct. 9 to Nov. 1, 1946, for third- to sixth-grade children.

[2] Includes all children surveyed. School sold milk and ice cream only. Nutritive value of milk and ice cream eaten at school is included.

[3] Represents nutritive value of food brought into family and school kitchens before preparation for eating. Nutritive value of child's diet was related to recommended allowances of the National Research Council (1948), proper for age and sex, separately for food energy value and each of 8 nutrients. Diet was then classified by the nutrient satisfying the recommended allowances least into 1 of 3 categories. See Appendix table 33.

[4] Children received 4 or 5 school lunches during week of food record. Nutritive value of school lunches is included.

[5] Age at last birthday. 4 children in Control School and 1 child in Lunch School 13 to 15 years of age are omitted in classification by age.

[6] See appendix D, page 85, for computation of household size in equivalent persons.

[7] No report of income was received for 24 families of children in Control School and 18 families of children in Lunch School.

TABLE 29.—*Families' consumption of food, 1947* [1]

School attended by children of family	Families	Family size, in equivalent persons [2]	Average quantity consumed by family per person per week [3]										
			Milk, cream, ice cream, cheese [4]	Eggs	Meat, poultry, fish [5]	Dry beans and peas, nuts [6]	Potatoes, sweet potatoes	Tomatoes, citrus fruit	Green and yellow vegetables	Other vegetables and fruits [7]	Grain products [8]	Fats, oils [9]	Sugars, sweets
	No.	*No.*	*Qt.*	*Doz.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Control School	53	4. 59	3. 66	0. 49	2. 09	0. 37	2. 64	1. 71	1. 12	2. 60	2. 77	0. 90	1. 10
Lunch School	44	4. 53	3. 94	. 54	2. 26	. 36	3. 27	1. 86	1. 40	2. 81	2. 92	. 82	1. 13
	Relative food consumption (Control School=100)												
Lunch School	-------	-------	108	110	108	97	124	109	125	108	105	91	103

[1] Based on 7-day food records, May 5 to June 1, 1947, for families of third- to sixth-grade children.
[2] See appendix D, p. 81, for computation of family size in equivalent persons.
[3] Averages per person per week for families were computed by dividing total food consumed from family food supply by family size in equivalent persons.
[4] In terms of fluid whole milk equivalent: Minerals and protein were taken into account in measuring fluid-milk equivalents for cream, ice cream, evaporated milk, and cheese.
[5] Excludes bacon and salt pork.
[6] Includes dry weight of cooked or canned dry beans, peas, lentils. Includes shelled weight of nuts.
[7] Includes fresh fruit equivalent of dried fruit, by weight.
[8] Includes two-thirds of weight of commercially baked goods added to weight of flours, meal, and cereals.
[9] Includes bacon and salt pork.

TABLE 30.—*Nutritive value of families' diets, 1947* [1]

School	Families	Average nutritive value of families' diets per nutrition unit per day [2]								
		Food energy value	Protein	Calcium	Iron	Vitamin A value	Thiamine	Ribo-flavin	Niacin	Ascorbic acid
	No.	*Cal.*	*Gm.*	*Gm.*	*Mg.*	*I. U.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Control School	53	3, 160	85	0. 811	16. 4	7, 140	2. 05	2. 19	19. 7	92
Lunch School	44	3, 270	90	. 872	16. 8	7, 100	2. 11	2. 27	20. 2	104
		Relative nutritive value (Control School = 100)								
Lunch School	---	103	106	108	102	99	103	104	103	113

[1] Based on 7-day food records for families of third- to sixth-grade children.

[2] Represents nutritive value of food brought into family and school kitchens before preparation for eating. Averages are based on number of families studied (col. 2). For method of computing average nutritive values per nutrition unit per day, see appendix D, page 85.

TABLE 31.—*Distribution of children's diets in relation to families' diets, Control School, 1947* [1]

Nutrient	Children's diets with specified relationship to families' level of diet quality [2]				Nutrient	Children's diets with specified relationship to families' level of diet quality [2]			
	All	Lower	Same	Higher		All	Lower	Same	Higher
	Percent	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*	*Percent*
Food energy value	100	27	62	11	Thiamine	100	17	81	2
Protein	100	21	69	10	Riboflavin	100	11	79	10
Calcium	100	11	59	30	Niacin	100	24	74	2
Iron	100	21	77	2	Ascorbic acid	100	14	76	10
Vitamin A value	100	16	73	11	Least satisfactory essential	100	21	54	25

[1] Based on 7-day records kept by homemaker, May 5 to June 1, 1947, for third- to sixth-grade children and their families.

[2] Includes all 63 children surveyed in Control School. School sold milk and ice cream only. Diets of children and families were placed on a common basis by classifying them into 4 broad levels by degree to which they met National Research Council recommended allowances for each nutrient. The children were then divided into a lower, same, or higher level of diet quality compared with that of their families.

FACTORS INFLUENCING FINDINGS

It is recognized that at best the school lunch can make only a relatively small contribution to the child's diet over a period of a year. Only 5 meals out of 21 can come from the school lunch in any one week. Since the schools studied were in session only 185 days of the 365 days of the year, a maximum of 17 percent of the child's meals for the year might be obtained at school, or not more than one-fourth of the meals per week while school was in session. Except under unusual circumstances most children will receive a meal of some sort at noon. Whether it is obtained at restaurant, at home, or is brought to school by the child, the meal will make some contribution to the day's intake of various nutrients. This will tend to reduce the possible differential attributable to the school lunch.

In addition to the relatively small contribution of school lunches, a number of other factors affect interpretation of the data in this study and may help to explain why the differences between the children with and without the school lunch were not more marked.

Health and Nutritional Status.—The initial health status of the children from both schools was found to be good, as indicated by only mild symptoms suggestive of nutritional deficiency. Under such conditions, an improvement in general health would be rather difficult to demonstrate. Furthermore, in view of the present techniques for measuring nutritional status, slight improvement occurring in healthy children might not be measurable.

Participation in the School Lunch Program.—The extent of participation of the children in the school lunch varied from week to week. There was also considerable variation in the extent to which the different age groups and the two sexes participated. The records of the child's lunch participation covered a 6-week period at the time of the examinations. These records do not indicate the extent to which the child participated in the school lunch throughout the entire year. Incomplete records make it difficult to determine the degree to which the child's participation during the experimental period was representative of the entire year.

Home Diets of Children.—The home diets of the families and their children in the subsample studied in both schools were fairly good for most nutrients. Thus the dietary improvement that might result from a good school lunch becomes less significant. It is not known whether these families were typical of all families in the school community. The diets of children not having a school lunch were poorer than those with a school lunch, regardless of which school they attended. However, the 1948 home diets of children without a school lunch were poorer in the Lunch School than in the Control School. The diets of the families studied, were better in the spring of 1948 than in the spring of 1947.

Socioeconomic Status of Families.—The findings may have been influenced by the fact that the families of children in the groups with and without school lunches were not exactly comparable. At first it appeared that the two groups were similar in socioeconomic resources. A number of differences appeared after the data had been collected and analyzed. The quality of the home diets differed. The lunch group contained the 10 percent of the children who were deemed

in need of lunches but unable to pay for them. In the Lunch School the lunch group was weighted by a heavy proportion of children from a rural section whose families used appreciable amounts of home-produced foods. A large number of the homemakers in the Control School were employed outside of the home. All of these factors doubtless had some effect on the findings of this study.

SUGGESTIONS FOR FUTURE STUDIES

When working with human beings under circumstances of everyday living, it is difficult to approach conditions of the controlled laboratory study. The following suggestions, based on the experience of the project described in this report, are intended as a guide for those who contemplate undertaking studies of the influence of a school lunch on the nutrition and diets of children.

A school lunch in itself may not have much influence upon children who are initially in good nutrition because the school lunch can account for only about 15 to 20 percent of a child's yearly food consumption. Furthermore, when the nutritional status of the children is already good, the home diets and the lunches brought from home are probably of fairly high nutritive value. In an area where the children are in poor nutritional condition, the impact of a good school lunch upon the health and dietary habits of the children may be more significant.

Before any study is undertaken, the school lunch should be investigated to make sure that it is and will continue to be good from the standpoint of both nutritional quality and acceptability. A poor school lunch may contribute no more and perhaps even less of some nutrients than the child would secure from a lunch brought from home. Unless the school lunch is acceptable to the children, they will not continue to buy it for any long period and the sample of children taking a school lunch may change. The reasons why some children do not take school lunch should be determined by interviewing both mother and child. In these cases, quality of the lunches carried from home or obtained elsewhere should be appraised.

The Sample

In order to simplify evaluation of results, there should be only two groups, the children regularly receiving the lunch and those who receive no school lunch. These groups should be as comparable as possible in all other respects. Before the study starts, the groups should be examined to see that they are parallel in age and sex, have similar home diets, and economic, racial, and religious backgrounds, and live in comparable neighborhoods. The school enrollment should be large enough to permit matching or pairing the children with respect to age, sex, and other characteristics. After the children in the two groups are paired, there should be 20 to 30 children of the same sex in each age group. If a subsample is used for any purpose, it should be representative of the entire group in as many respects as possible.

These studies might well be limited to children between the ages of 7 and 10. For adolescent groups larger samples would be required.

Considerable variation in the time when the growth spurt occurs may introduce unknown factors in the interpretation of height-weight data and certain physical signs. Food service and other situations in high schools may be entirely different from those in grade schools and may require an approach different from that used with younger children.

The community in which the study is contemplated should be considered from several angles. The population of the community should be stable. If it is shifting or migratory, the sample is likely to change before the study is completed. The community should be fairly stable from an economic standpoint, without seasonal peaks of employment or continued marked trends upward or downward in economic status. An economic crisis may be reflected both in the meals that the children secure at home and in their school lunch participation.

Experimental Design of the Study

Because it is exceedingly difficult to segregate the effects attributable to a school lunch, every means should be employed to reduce to a minimum the variables likely to distort the findings. Regardless of the experimental plan chosen, the physical, dietary, biochemical, and other tests should be made as close together as possible. If some time must intervene between the various tests, it is preferable that the dietary study precede the others. Where feasible, the study should include two school years and the results of the first year checked against those of the second to detect possible influence of uncontrolled variables.

A semicontrolled study can be carried on in a school where a school lunch is being initiated and one-half of the students receive the school lunch regularly throughout the year and the other half do not. To insure constant participation, the children in the school lunch group should be provided with free lunches during the experiment. Since a study such as this will most likely be carried out where the nutritional status is initially rather poor, it may be advisable to provide the families of the group not participating in the school lunch with a sum of money equivalent to the cost of the food in the school lunch furnished the other group to equalize the economic situation during the experiment. Otherwise the financial saving for the families of the free lunch group may be used in improving the home meals so that the children get not only a good lunch at school but improved meals at home.

With the above plan, the initial measurements should be made at the start of the school year to insure that the groups with and without school lunches are comparable. The final measurements may be made at the end of the school year or the study may be extended through another year. During the second year measurements should be made at the same seasons as the first year, to take account of the summer vacation and seasonal changes in the mode of living and eating patterns of the children.

A simpler study would be one in which the children in a lunch school are paired for examination with those in a no-lunch school in communities as comparable as possible in socioeconomic conditions, including home food habits. The lunch school preferably should be one in which all of the children participate regularly in the lunch program. An alternative would be one in which the records of the lunch

participation are complete for a period of a year or more prior to initiation of the study and hence could be used to segregate the children into groups with and without school lunches. Where such a study is possible with strictly comparable samples, the examinations might be made only once, late in the school year. The influence of the school lunch would be judged on the basis of the comparison of the two strictly paired groups. Because of the variability in school lunch participation, difficulty in securing a sufficiently large sample of children who have had the school lunch regularly may be the chief problem in this type of study.

Repeated observations on the same children over a period of years may be required for appraising the results of long-continued participation in a school lunch, as in any program of supplemental feeding. Some nutritional effects may be immediate in response to supplemental feeding; others might require months even if the supplement represented a major diet improvement; still others, such as growth rates, could require years to effect a response.

A large school in a very stable community would be required to obtain comparable samples of children who were regularly with and without a school lunch over a number of years. Such a study should exclude young children who have been in school 2 years or less because the possible cumulative effects of a school lunch would not be apparent.

A longitudinal type of study to measure the cumulative effects of the school lunch on the child might well start with the nutritional status and food habits of comparable samples of preschool children who were entering separate schools with and without a school lunch program. Children in both schools would be examined yearly at the same season, and the data analyzed for progressive changes from year to year. Matching samples of at least 50 to 100 children in each group would be needed, depending on the range of variables in age, home diets, and other conditions likely to affect the nutritional status and the size of the sample remaining at the end of the study.

Physical Examinations

Since the physical examination is so largely dependent upon a subjective evaluation, it is advisable to limit it to a few important signs and retain the same examiner throughout. By having the same physician make all of the examinations, interphysician variation in the examinations will be eliminated. The signs should be reported and analyzed on the basis of the degree of severity of the condition. A detailed standard description of the degree scale of physical signs should be established in advance, and wherever possible an objective base should be used for the various degrees of severity of the condition. To aid the physician in maintaining a constant base for his examinations, especially when months must intervene before follow-up examinations, colored photographs of the different conditions considered abnormal should be available at all times. Along with the subjective records of the physical examinations, it may be desirable to explore the use of colored photographs of the children taken at the start and finish of the study. The photographs should be taken under controlled conditions to facilitate the evaluation of any changes they may show.

Biochemical Tests

Only those biochemical tests that are likely to be influenced by the experimental set-up should be used. For instance, it may be unnecessary to determine total serum protein. There is already sufficient evidence that the total serum protein as well as serum albumin shows only a minimal response to dietary changes for children in good nutritional status.

After the biochemical tests have been chosen, the technicians should have maximum skill in their techniques before the first child is examined. Before the technician has mastered a given procedure, his results may be consistently too high or too low. Improvement in skills through practice on the survey sample may lead to erroneous differences between the first and last portions of the sample examined, and to wrong conclusions if a preponderance of the first children examined belong to one group.

Proper equipment and facilities should be available for handling the blood samples promptly and efficiently. For instance, if ascorbic acid analyses are to be made, facilities should be available for proper refrigeration of the samples until they can be transported to the laboratory for analysis.

In evaluating the significance of biochemical findings, it would be helpful to have results on two blood samples from the same child. If it is impossible to secure duplicate blood samples on all children, it would be highly desirable to do so at least on a representative sample from each group. The same subgroup should be used at each period. These duplicate blood samples should be taken at each period within a few days of each other and the consistency in the findings for each child compared with the differences between the groups.

Dietary Records

Accurate information on the food intake of individual children is difficult to secure. Chemical analyses of duplicates of meals eaten by the child are expensive even where laboratory facilities exist and would tend to limit the size of the sample. Various psychological and economic conditions may also interfere with such a procedure.

By the individual interview method the child's response to the queries of the nutritionist is likely to be influenced by the latter's personality, professional approach, interviewing techniques, and other personal attributes. The condition under which the dietary records are secured may have some influence on the results. At present, it is impossible to make proper allowance for these factors in dietary investigations. A control study might be made in the school to assess the accuracy of the information reported on the foods consumed. This could be done by having one person record the kinds and amounts of food on the plate when the child leaves the cafeteria line and again after he has completed his meal, and having another nutritionist take a dietary record from the child an hour or so after the meal. Comparison of the two records should indicate the reliability of the methods used.

It is necessary to determine not only what the child eats in school but also what he gets at home and how it is supplemented by the school lunch. In order to get an over-all picture of the day's food intake, a 24-hour dietary record is necessary. What a child eats on any one day may not be a true reflection of his "eating pattern," and exactly how many days are required to reveal the pattern probably varies from group to group. At least 3 days and perhaps 7 are needed before a true picture can be secured of a child's food intake. If less than a 7-day record is used, the problem arises as to how the days should be spaced throughout the week to take account of irregularities in food service at home.

An alternative to the interview method is to have each child keep his own record of food consumption. This reduces the effect of the personal relationship of interviewer and child but must be limited to children of 10 years or older. Another possibility is to have the mother record the child's consumption. One disadvantage of this method is that the mother does not know what the child eats outside the home. The error due to such nonreporting would increase with the age of the child. To minimize the difficulty, consideration should be given to a combined record from the child, especially for foods eaten away from home and from the mother for foods eaten at home. In addition, a history of the food habits of the child is desirable, particularly in survey studies where the children are observed only once (*29*).

Analytical treatment of the dietary records should be considered in advance in some detail to insure collection of the necessary information. If there are indications that the results of the dietary examination do not accurately reflect the child's intake either in foods reported or in serving portions, it would not be advisable to spend either the time or the money required for detailed calculations or analyses of the various nutrients. If only gross reports on the child's food, such as number of servings with sketchy or no data on size of servings is obtained, a simple evaluation of the diet in terms of food groups may serve to give gross dietary scores, but not for purposes of correlating the biochemical and dietary data.

Lunch Participation

If it is impossible to maintain constant participation of the groups, records should be kept of the days when each child receives the school lunch. These records should be maintained throughout the study. Where it is impossible to do this, records should be kept at least 2 months prior to the study. From these records, two groups of children should be selected for the final study: The lunch group, including those children who received the lunch 90 percent or more of the time; and the group without lunches, including those children who received the lunch 10 percent or less of the time.

OTHER SCHOOL LUNCH STUDIES

The problems and variables which have made interpretations difficult in this study may help explain some of the conflicting reports

in the literature on appraisals of the value of school lunches. Only a few reports of such school lunch studies have been published.

In England, no significant influence of the school meal upon hemoglobin levels could be seen by Davidson and coworkers (*15*, *16*, *17*), or by Dobbs and others (*18*). A more extended study by Pierce (*34*) failed to show any significant effect of a hot school lunch upon the general health, hemoglobin, or serum protein and vitamin C levels. In the latter study, it was noted that the home meals of children who received the school lunches were of much lower nutritive value than those of the children who went home for lunch. This, together with the marked difference in the food situation in England compared with that in the United States, may make it impossible to compare the effects of the school lunch in the two countries.

From the United States only a few reports are available. One made in a part of Florida where nutritional disturbances were very common showed that a school lunch providing a more than liberal amount of all the nutrients plus supplements of vitamins or minerals, where needed, produced a considerable improvement in the health and well-being of the children (*1*). Another study in a rural county in South Carolina where most of the children were underweight and where the dietary patterns were particularly poor, showed that a complete lunch served in one school produced a more marked improvement in physical and biochemical findings than a "partial" lunch served in another school (*28*). These findings are in contrast to those of Mack (*26*) who found that the school lunch fed to children in Pennsylvania produced no improvement in their nutritional condition. She attributed this to the poor planning and supervision of the meals served in school. Two other studies dealing with the nutritional status of school children were made by Kohn and colleagues (*24*) and by Stamm and Wiehl (*38*).

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APPENDIX A. REPORT OF THE CONFERENCE ON SCHOOL LUNCH STUDY[1]

INTRODUCTION

The Committee on Child Nutrition assumed that its function was to outline plans for determining the effect of a school lunch program on the well-being of the children, and also to obtain such evidence as is possible on what constitutes a good school lunch for different situations.

The Committee is aware that there are a goodly number of studies, informal or experimental, that give some evidence on these points. These scattered studies should be brought together, compiled, and reviewed carefully. After this is done there will still be need for further investigations to get more adequate information.

Our Committee decided that evidence could be best obtained by carrying out a well-controlled experimental project in specific school situations, both urban and rural, involving relatively large groups of children.

The Committee has, therefore, outlined such a project.

GENERAL PLAN

The general plan of the project follows:

1. Select a school or schools which may or may not have had a school lunch.
2. Make a check-up of the school at the beginning.
3. Institute a desirable school lunch program, or modify the existing one to meet standards.
4. At the end of the study period, reapply the same measures as at the beginning.

MEASURES TO BE APPLIED

A. Physical:
   1. Clinical examinations by physicians, including examination of skin, hair, mouth, eyes, etc., for signs of deficiencies.
   2. Dental examinations of gums and teeth.
   3. Biochemical studies of blood by the micro-method of Bessey and others for serum proteins, hemoglobin, phosphatase, vitamins A and C, and possibly certain members of the B complex.
   4. Possible studies of excretions on sample groups.
   5. Some test of physical fitness, as, for example, the Brewer-Gallagher step test.
   6. Anthropometric measures of length and weight; and possibly one or two others, as hip breadth and chest circumference.

B. Tests of attitude and of knowledge to be developed in cooperation with the education group.

C. School record:[2]
   1. Regularity of attendance.
   2. Causes for absence.
   3. Physical condition as judged (a) by classroom teacher; (b) by record of illnesses during period of study.
   4. Behavior[2]
      (General, as noted by teacher)
   5. Scholastic progress.

[1] Washington, D. C., November 27 to 29, 1945. Report of Committee I—Child Nutrition. Unpublished. Members of the committee: Lydia J. Roberts, Chairman, Committee on Dietary Allowances, Food and Nutrition Board, National Research Council, Chairman; Esther L. Batchelder, Head, Division of Food and Nutrition, U. S. Bureau of Human Nutrition and Home Economics, Secretary; Harold Stuart, M. D., Professor of Child Hygiene, Harvard School of Public Health; Barbara Henwell, M. D., Assistant Director, Division of Research in Child Development, U. S. Children's Bureau; W. H. Sebrell, M. D., Chief, Division of Physiology, National Institute of Health.

[2] Suggestions from report of Committee III [Educational Administration in relation to the School Lunch] have been incorporated.

D. Lunch records.[2]
   1. Regularity of participation.
   2. Behavior in line and at table.
   3. Sharing in activities connected with the lunch.
   4. Checks on food eaten, including choices and portions left uneaten.

E. Tests of food habits of child and family:
   1. Diet histories taken from child at beginning and at intervals thereafter.
   2. Conferences with parents before, during, and after—probably on a selected sampling basis.
   3. Commodity checks for such foods as milk and whole or enriched grain products.
   4. Home-produced foods.

F. Analysis of nutritive value of foods actually eaten in the school lunch as related to gross food supply and waste.

If possible, include analysis of home meals of typical families to determine what they contribute to the day's food needs.

THE LUNCH PROGRAM

A. The lunch:
   1. Provide at the outset a lunch that meets specified nutritional standards, as, for example, one-third of the calorie and protein and one-half of the mineral and vitamin daily requirements.
   2. Work out a variety of food patterns suited to different localities and school situations that meet these requirements.
   3. As data on home and lunchroom food consumption are obtained, modify the nutritional standards as needed.

B. Nutritional management and education:
   1. Employ nutritionist to be responsible for the menus and the quality and quantity of food served and for directing the nutrition education program.

EXPERIMENTAL SET-UP

The committee has outlined in some detail a project which would effect these ends. The following specifications were assumed:

1. An urban and a rural set-up.
2. In each situation there would be involved a total of 1,000 children, 500 to be used as the experimental group, 500 as controls. In the two set-ups, 2,000 children would be involved.
3. The experiment in the school should be planned to cover at least two school years. The total project should be for three years to allow time for workers in preplanning and in working up the results.

The project has been outlined as a meticulous research undertaking rather than as a survey. The plan includes a considerable number of specialized workers.

a. An advisory committee built around the present committee as a nucleus, with the addition of a few representatives from such fields as educational measurements and physical fitness.
b. A project director.
c. A professional staff, including physician, dentist, biochemist, nutritionist, anthropometrist, public health nurse, specialist in tests and measurements, and biostatistician.

It assumes other services and staff as:

a. An adequately equipped and operated lunchroom.
b. Competent teachers and administrators.
c. Statistical services for working up the material.

WHAT SUCH A STUDY SHOULD CONTRIBUTE

1. The study should, first of all, contribute evidence on the problem for which it is set up; that is, to what degree can a well-managed school lunch be made to contribute to the health, physical status, food habits, and school progress of the children?

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[2] See footnote 2, p. 76.

2. It should, in addition, be the basis for setting up standards for:
   a. The essential constituents of a school lunch.
   b. Types of school lunch patterns suited to various situations, such as:[3]
      (1) Pupils from families with different food habits and customs.
      (2) Pupils from homes where the parents are employed outside most of the day and pupils from homes near the school where good meals are served regularly.
      (3) Pupils who come to school without breakfast or with a very inadequate breakfast and pupils who stay for after-school activities.
      (4) Pupils who carry a physically active program and those who carry a more sedentary one.
      (5) Pupils of different age levels, as 5- and 6-year-olds vs. adolescents.
      (6) Pupils from families in different economic and home situations—for example, pupils from rural areas with depleted soil vs. pupils from rich rural areas, those having year-round gardens vs. those having few or no gardens.
      (7) Pupils living under different climatic and geographic conditions—for example, warm and cold climates, areas of dietary deficiency, etc.
   c. Possible procedures by which school people might check the benefits of the lunch in their own situations.

APPENDIX B. PHYSICAL SIGNS USED IN CLINICAL EVALUATIONS OF NUTRITIONAL STATUS

The physical signs selected for use in this study are described in the following excerpts from the report on nutrition studies by Sandstead and Anderson (*37*).

Physical Measurements

The present opinion among most nutrition workers is that anthropometric measurements, other than height and weight, give little indication of current nutritional status. Other measurements unquestionably are useful in studying particular anthropological groups, in following the nutritional progress and growth of school children, and in controlled nutrition studies.

In examining large numbers it usually is not feasible to completely undress individuals for measurement. For general purposes, weights may be taken in ordinary business or working clothes, but without coat or other heavy outer clothing. Shoes also should be removed for height and weight measurements. Height should be taken in an erect position, preferably with the back against a wall.

GENERAL APPEARANCE

Unfortunately, it is impossible to establish definite standards and it is recognized that competent and experienced observers working individually show disagreement in individual cases. However, we believe it is desirable that an estimate of the general appearance of the patient be made, and when physicians work together periodically, a certain degree of uniformity is obtainable. Recorded poor, fair, or good.

EYES

Blepharitis

This is an inflammation of the eyelid, particularly of the border. Recorded 0, 1, 2, or 3. Blepharitis and crusty eyelids are usually produced by bacterial infections, but are occasionally associated with nutritional deficiency.

Palpebral Conjunctiva

To facilitate rapid examination, attention is directed chiefly to the conjunctival surface of the lower lid.

Conjunctival folliculosis.—This is indicated by presence of definite lymphoid follicles on the palpebral conjunctiva. The condition may be difficult to dis-

[3] From report of Committee III [Educational Administration in Relation to the School Lunch].

tinguish from true trachoma, but the clinician should record his opinion if trachoma is suspected. Recorded 0, 1, 2, or 3 as follows:

(1) Folliculosis confined to the outer half of the lower lid and of mild degree.
(2) Folliculosis extending to the other half of the lid and of mild to moderate degree.
(3) Folliculosis of the whole lid and of severe grade.

Bulbar Conjunctiva

Thickening.—Recorded 0, 1, 2, or 3. The mildest changes can be seen only with a slit lamp, but gross examination is nearly as useful for routine examination.

Lesions at Outer Canthi of Eyes

These are recorded 0, S, 1, or 2 in the following manner.

(S) Scarring, alone.
(1) Scaliness, dried exudate at outer canthi.
(2) The preceding condition plus definite inflammation.

This condition is commonly caused by eye infections, but may also result from nutritional deficiency.

GUMS

Gingivitis.—Recorded 0, 1, 2, or 3.

(1) Inflammation (producing a red or purple color) and slight swelling limited to the gingival margin and the interdental papillae. On firm pressure there may be slight bleeding.
(2) There is mild injection and swelling of the entire gum. There is also mild but definite sponginess with mild bleeding on firm pressure.
(3) There is marked swelling, injection, and sponginess. The gums bleed spontaneously or on slight pressure.

TONGUE

Color

Red.—Recorded 0, 1, 2, or 3.
Magenta.—Recorded 0, 1, 2, or 3.

Papillae, Filliform

Atrophy.—Recorded 0, 1, 2, or 3.
Hypertrophy.—Recorded A or P.

Papillae, Fungiform

Atrophy.—Recorded 0, 1, 2, or 3.
Hypertrophy.—Recorded A or P.

Swelling.—This is frequently evidenced by indentations produced by the teeth along the tongue margins. Recorded A or P.

Fissuring.—Recorded 0, 1, 2, or 3.

SKIN—GENERAL

Xerosis.—Dryness of skin. Recorded 0, 1, 2, or 3.

Folliculosis.—Recorded 0, 1, 2, or 3. For routine survey purposes attention is directed to the outer surfaces of the arms only.

(1) A few scattered hyperkeratotic follicles present. These are most readily evident by palpation, but can usually be seen under side lighting.
(2) Moderate folliculosis readily evident by visual examination and palpation.
(3) Severe folliculosis. This is usually accompanied by considerable xerosis.

APPENDIX C. METHODS USED FOR ANALYSES OF NUTRITIVE CONTENT OF SCHOOL LUNCHES

Collection of Samples and Preaparation for Chemical Analysis

Samples of lunches served to the fourth to sixth grade children were taken for analysis. Five plate lunches were selected while the food was being served. Each food in the lunches was weighed separately. The average weight of each

food in the plate lunch, except milk, was used in the preparation of a composite lunch. This composite was ground in a Waring Blendor and brought to a volume of 1 liter, or preferably to 900 gm. It was stored at —20° C. until thiamine and riboflavin analyses could be run.

After these analyses were made between 400 and 500 gm. of the remaining sample were dried for other analyses. Since a vacuum oven was not available for removing such large quantities of water, the samples were air dried. They were first placed in front of an ordinary electric fan until excess visible water was removed, then placed in a modified home dehydrator until there was no further loss of weight. The heating unit in the dehydrator was replaced with a drawer equipped with screen columns for holding calcium chloride and a pan to catch the drip. The dehydrator contained an electric fan to keep dry air in circulation. The dried samples were ground to a fine powder in a Wiley Mill and stored in screw-top bottles.

At the time the lunch was served a separate composite of foods recognized to contain ascorbic acid was prepared in metaphosphoric acid and analyzed the same day.

Analytical Methods

Food energy value was determined by the use of the oxycalorimeter similar to that described by Benedict and Fox (*6*) ; protein by the Kjeldahl-Gunning-Arnold method (*2*) using mercuric oxide as a catalyst and distilling the ammonia into boric acid (*27*) ; fat by the direct ether extraction method (*2*) using the Bailey-Walker Extraction Apparatus (*43*). Calcium determinations were carried out essentially as described by Frear and Kahlenberg (*20*) except that the samples were not fused with sodium carbonate.

Chemical procedures were used for thiamine and riboflavin analyses and were essentially those described in Methods of Vitamin Assay (*3*). The acid extract was incubated overnight at 38° C. Riboflavin was determined on the same filtrate. For removal of interfering fluorescent substances an aliquot was treated with 2 ml. of 4-percent potassium permanganate for 1 minute and excess permanganate removed with a minimal amount of 3-percent hydrogen peroxide. Adsorption and elution were omitted (*36*). The increment technique was used for the fluorometric readings and calculations.

Since methods for total ascorbic acid seemed unsatisfactory for these composites, only reduced ascorbic acid was measured, using the 2, 6-dichlorophenol-indophenol method. The visual titration method (*3*) was used for the first 20 samples since a photoelectric colorimeter was not available in the field. For subsequent samples a portable Lumitron colorimeter was used and determinations made by the xylene extraction method (*31*).

Calculated Nutritive Values

The nutritive values for canned fruits and vegetables from the U. S. Department of Agriculture's Tables of Food Composition in Terms of Eleven Nutrients (*42*) were used for calculations for plain fruits and vegetables, canned or cooked. This table was also used for fruits and vegetables served raw and for all other foods eaten as marketed, such as milk, bread, and eggs. For mixed and combination foods, as soups and coleslaw, tables by the United States Public Health Service (*11*), Bowes and Church (*10*), and Taylor (*41*) were used. When no figures were available for a specified dish, such as kidney bean salad, an attempt was made to approximate the proportion of ingredients from a recipe.

APPENDIX D. METHODS USED IN DIETARY SURVEY

Selection of Families and Children

The dietary survey was confined to a subsample of the children in the third to sixth grade of the Control and Lunch Schools and of their families. Though the number of reports obtained was small, results are considered reliable, since

findings for the periods studied—fall 1946, spring 1947, and spring 1948—are consistent.

From an alphabetical list of families of children in the third to sixth grades in each of the two schools, every fourth family was selected in the fall of 1946 to keep food records. Each family was listed only once and all the children in these grades found in the families were included in the study. Insofar as possible, the same families and children were covered in the spring of 1947. Because of the number of families unable or unwilling to keep the records, additional samples were similarly drawn each time to obtain the desired total of 50 records from the families served by each school. Actually food records were collected for 63 children in the Control School and for 57 in the Lunch School, but the

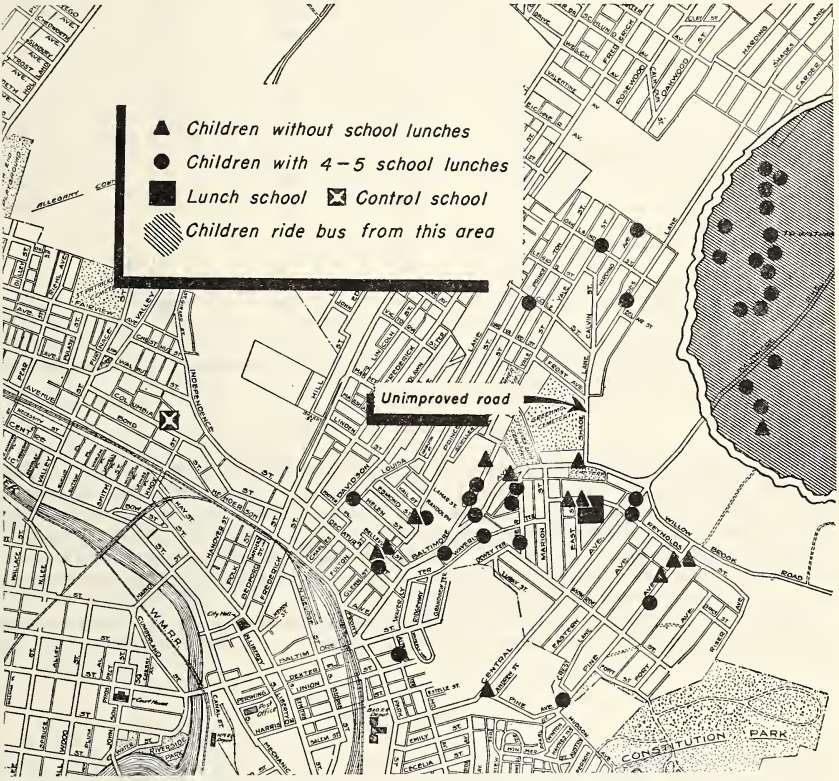

FIGURE 9.—Residence of children in relation to location of school and school lunch participation, spring 1947.

records of 21 children in the Lunch School who had fewer than four school lunches during the week of study were excluded from final tabulation.

On the whole, families that were not able or willing to cooperate in the survey and cooperating families served by each school in the spring of 1947 were fairly comparable with respect to the more important points investigated, as shown in table 32.

Number of children covered in each period are shown in table 22. A distribution of children in the Lunch School by place of residence in relation to location of school and participation in the school lunch program for the spring of 1947 is shown on the map (fig. 9).

TABLE 32.—*Selected facts about cooperating and noncooperating families in sample for home dietary survey, spring 1947* [1]

Item	Families drawn in sample, spring 1947			
	Control School		Lunch School	
	Cooperating	Unable or unwilling to cooperate	Cooperating	Unable or unwilling to cooperate
Families—number	53	36	44	36
Families—percent	60	40	55	45
Average family size—persons	5. 0	5. 2	5. 2	5. 1
Average rental value of home—dollars	29	33	31	30
Owned homes—percent	36	53	54	53
Homemakers:				
Employed outside home—percent	13	19	2. 0	21
Formal education—years	9. 2	8. 5	9. 5	8. 5
Average age—do	36	36	38	36

[1] Families of third- to sixth-grade children in May 5 to June 1, 1947, collection.

COLLECTION OF DATA

The forms used in the collection of data for October 9 to November 1, 1946, and May 5 to June 1, 1947, included: (1) A record card, (2) a report of family income for the month prior to the interview, and (3) a 7-day food record which showed the food consumed by the family as a whole and by each of the third- to sixth-grade children in the family individually. Sample excerpts of the food records are shown in Nutrition Surveys: Their Techniques and Value, bulletin of the National Research Council (*29*).

Local women meeting certain qualifications were employed to interview the homemakers to obtain the needed information and were given intensive training for 3 to 4 days preceding collection.[4]

RECORD CARD

The record card, giving general information and some socioeconomic facts about the family, was filled for all families whether or not they were able or willing to give the food data. The socioeconomic data gave a basis for comparing the cooperating and noncooperating groups of families in the dietary survey.

FAMILY INCOME SCHEDULE

The family income schedule covered the net cash income received by families from all sources during the month of September for the fall collection and during the month prior to the interview for the spring collections (table 1).

[4] Local interviewers who assisted in the home dietary studies: Edith Ballarion, Ruth Bowan, Bonita Cessna, Olive Claar, Anna Marine Dellinger, Helen Dye, Mildred Flynn, Althea Goetz, Leona Hanarote, Helen Hinkle, Mildred Hunter, Elizabeth Jones, Virginia Laight, Loretta La Neve, Ursula Lindner, Irma Marley, Gene Miller, Naomi Nicholls, Margaret Showalter, Mary Smouse, Mary Straw, Edith Street, Nina Wolford, Grace Wood.

FOOD RECORD FOR FAMILY AND CHILD

A weighed inventory of all foods on hand was made by the interviewer and the homemaker at the beginning and end of the 7-day period. Scales were left in each home for the homemaker to weigh foods brought into the home during the week. An interviewer checked daily the entries of the homemaker, obtained an estimate of the quantity of foods given away, fed to animals, or wasted, and found out the number of meals furnished from the home food supply to each family member, boarder, guest, or paid helper. The family's 7-day food consumption equaled foods on the beginning inventory, plus foods brought in during the week, minus foods on the closing inventory and any given away, fed to animals, or thrown away.

Menus for meals, packed lunches, and between-meal snacks were recorded daily by the homemaker to provide a continuous 7-day record of the food consumed by each third- to sixth-grade child in the family. The quantity of each food eaten by the children was recorded in household measure or as a proportion of the quantity used by the family. Recipes for mixed dishes prepared in the home and the estimated proportion consumed by each of the children were also obtained from the homemaker.

Kind of physical activity (adults only), age, and other related information was recorded for each person eating from family food supplies and used in appraising quality of diets.

FOOD SERVED AT SCHOOL

Data on the kinds of foods used in the school lunch, their weight before preparation, and the number of children and adults fed were obtained from the head cook in the lunchroom for each school day during the survey period. From this the average per capita quantities of each food used in the lunch were derived day by day and added to the quantities of food eaten from family food supplies for any day that a school lunch was eaten. No account was taken of additional servings or food left on plates.

A spot check of seconds and weighed plate waste was made at one table for each grade during one school week, June 5 to 11, 1947. In that week foods of which seconds were eaten by one-third or more of the children were orange juice, mashed potatoes, meat sandwich, sauerkraut, frankfurter sandwich, and margarine on raisin bread. The children in the fifth and sixth grades took seconds about twice as often as those in the third and fourth grades. During this week plate waste was low. On the average the highest waste occurred in food energy (30 cal.), protein (1 gm), vitamin A value (170 I. U.), and ascorbic acid (2 mg.) and amounted at the most to 2 percent of any nutrient intake (ascorbic acid).

ONE-DAY FOOD RECALLS FOR CHILD

Besides 7-day food records, 1-day food recalls were collected in the spring of 1947. The recalls were obtained for another group of children from the third to sixth grades of each school by a method of selecting families similar to that used for getting the 7-day food records. The kind of information obtained on the 1-day recall of food consumed by the child was similar to that obtained on the 7-day record except that it covered a much shorter period (the past 24 hours only) and that it was reported by the mother from memory, without previous notice, instead of being recorded.

In the spring of 1948, 1-day recalls of food consumption were used to save time and money. The ratio of the nutrient content of the 1-day to the 7-day diet of the child in the spring of 1947 was applied to the nutritive value of the 1-day diet in 1948 to get some indication of the probable 7-day diet at that time.

In two respects 7-day records seem preferable to 1-day recalls: (1) Record is likely to be more accurate than recall, (2) food consumption for 7 days tends to be more representative of an individual's diet in any season than food consumption for 1 day only. A greater proportion of diets are likely to be

TABLE 33.—*Three levels of National Research Council's allowances used in classifying children's diets according to nutritive quality* [1]

Age and sex group	Percentage of NRC recommended allowances	Average per person per day for specified dietary essential								
		Food energy value	Protein	Calcium	Iron	Vitamin A value	Ascorbic acid	Thiamine	Riboflavin	Niacin
		Calories	*Grams*	*Grams*	*Milligrams*	*International Units*	*Milligrams*	*Milligrams*	*Milligrams*	*Milligrams*
Children:										
7–9 years	100.0	2,000	60	1,000	10.0	3,500	60	1.00	1.50	10.0
	67.7–99.9	1,334–1,999	40–59	0.667–0.999	6.7–9.9	23.34–3,499	40–59	0.67–0.99	1.00–1.40	6.7–9.9
	66.6 or less	1,333 or less	39 or less	.666 or less	6.6 or less	2,333 or less	39 or less	.66 or less	.99 or less	6.6 or less
10–12 years	100.0	2,500	70	1,200	12.0	4,500	75	1.20	1.80	12.0
	66.7–99.9	1,668–2,499	47–69	.800–1.199	8.0–11.9	3,002–4,499	50–74	.80–1.19	1.20–1.79	8.0–11.9
	66.6 or less	1,667 or less	46 or less	.799 or less	7.9 or less	3,001 or less	49 or less	.79 or less	1.19 or less	7.9 or less
Girls:										
13–15 years	100.0	2,600	80	1,300	15.0	5,000	80	1.30	2.00	13.0
	66.7–99.9	1,734–2,599	53–79	.867–1.299	10.0–14.9	3,335–4,999	53–79	.87–1.29	1.33–1.99	8.7–12.9
	66.6 or less	1,733 or less	52 or less	.866 or less	9.9 or less	3,334 or less	52 or less	.86 or less	1.32 or less	8.6 or less
Boys:										
13–15 years	100.0	3,200	85	1,400	15.0	5,000	90	1.50	2.00	15.0
	66.7–99.9	2,134–3,199	57–84	.934–1.399	10.0–14.9	3,335–4,999	60–89	1.00–1.49	1.33–1.99	10.0–14.9
	66.6 or less	2,133 or less	56 or less	.933 or less	9.9 or less	3,334 or less	59 or less	.99 or less	1.32 or less	9.9 or less

[1] Adapted from Recommended Dietary Allowances. National Research Council Reprint and Circular Series No. 129, Revised October 1948.

graded low for a single school day than when "feasts" and "famines" in nutrients are averaged for 7 days. The best length of time to cover is not known. It probably varies with nutrients, depending on duration of body storage and interrelationships with other nutrients. Seven days may be unnecessarily long for some nutrients and too short for others.

Computations

Average Quantities per Person per Week.—The total food consumed by the family in a week was divided by the size of the family to give average quantities consumed per person per week. For this purpose 21 meals were counted as one person regardless of the meal or day, and regardless of the size or physical activity of the family members. The total number of meals served to all persons from family food supplies during the week was divided by 21 and the resulting figure was used for family size. The average quantities obtained are satisfactory for comparisons between groups of families similar in composition as were the families served by these two schools.

Average Quantities per Child per Day.—Average quantities consumed per child per day were obtained by dividing the week's consumption of home and school foods by one-third of the number of meals eaten at home and school by each child or group of children. For children eating all 21 meals at home and school, the week's food consumption was divided by 7.

Average Nutritive Values per Nutrition Unit per Day.—Average nutritive values per nutrition unit were obtained by dividing the total nutritive value of the food consumed from family supplies by family size in equivalent nutrition units, using a scale of relatives derived from the National Research Council's recommended allowances for calories and eight nutrients. For the scale, the dietary allowances of the physically active man were considered equal to one nutrition unit and allowances of other sex-age-activity groups for each nutrient were expressed in relation to those of the physically active man (*30*, *39*, *40*).

The nutritive value of the diet per nutrition unit was used in grading the individual diets. The ranges used for the three levels of quality with respect to different nutrients are shown in table 33.

Food Composition Data.—Nutritive values were taken from U. S. Department of Agriculture's Tables of Food Composition in Terms of Eleven Nutrients (*42*) and from unpublished data of the Bureau of Human Nutrition and Home Economics. Nutritive values of foods per pound, as purchased, were multiplied by the weight in pounds of foods as brought into the kitchen before preparation for the table.

Vitamin Losses in Cooking—Since nutritive values of food as purchased take no account of losses in cooking, the average destruction in cooking of the four most vulnerable vitamins—thiamine, riboflavin, niacin, and ascorbic acid—and its effect on the nutritive values of the children's diets has been estimated roughly. The variation in vitamin loss during cooking is known to be extremely wide, owing to the different methods of cooking in use among families. Estimates of losses in thiamine, riboflavin, niacin, and ascorbic acid were based on customary practices in food preparation, because of lack of information on practices in the homes of children covered. The over-all loss in cooking was considered to be greatest for ascorbic acid, about 20 to 25 percent; and about 15 percent for thiamine, 10 percent for niacin, and less than 5 percent for riboflavin.

After adjustment for cooking losses, only about 60 percent of the diets in the Control School and 80 percent of those in the Lunch School furnished two-thirds or more of allowances for ascorbic acid; that is, in each school, about 15 percent fewer diets had this level of ascorbic acid. The effect of adjustment for cooking loss on values for the B vitamins was slight.

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